ABSTRACTS OF NORTH AMERICAN GEOLOGY

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INTRODUCTION

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ABSTRACTS

04951 **Aamot, Haldor W. C.** Instruments and methods—Pendulum steering for thermal probes in glaciers [with French and German abs.]: Jour. Glaciology, v. 6, no. 48, p. 935–938, illus., 1967.

A new concept of attitude stabilization for thermal probes or coring drills in ice eliminates instability. The center of support is placed above the center of gravity. A lower and an upper hot point produce melt penetration. The ratio of their power levels is the basis of stabilization. This is provided by the automatic control of the heater in the upper hot point.—Author's abstract

Akella, Jagannadham. *See* Matsushima, Shogo. 04946

Akin, T. B. *See* Watt, Harold B. 04984

05196 **Albee, A. L.; Smith, J. L.** Geologic site criteria for nuclear power plant location: Soc. Mining Engineers Trans., v. 238, no. 4, p. 430–434, illus., 1967.

This article presents a series of guidelines by which the geologist can evaluate the likelihood of surface faulting and its probable extent at any given site in Southern California and Nevada. The information is intended primarily for geologists concerned with establishing design criteria for proposed nuclear plants.—Authors' abstract

Albright, J. C. *See* Miesch, E. P. 04987

Alder, B. *See* Oeschger, H. 04952

Alger, R. P. *See* Tixier, M. P. 04990

05074 **Allen, Ralph O., Jr.** Trace analysis of halogens by neutron activation: Iowa Acad. Sci. Proc. 1965, v. 72, p. 139–144, tables, 1967.

A procedure was developed by which trace quantities of chlorine, bromine, iodine, tellurium, and uranium could be quantitatively determined simultaneously in a single meteorite sample. Meteoritic material was irradiated with thermal neutrons. Carrier ions were added, the material was fused with sodium peroxide and the chlorine, bromine, and iodine were isolated. Distillation from a sulfuric acid solution removed the halogens from the bulk of material. After distillation, selective solvent extractions were used to separate and purify each of the halogens. The purified halides were precipitated as the silver halides, weighed, mounted, and counted by β, γ and/or β–γ coincidence counting techniques.—Author's abstract

05000 **Ames, Gerald; Wyler, Rose.** The earth's story: Mankato, Minn., Creative Educ. Soc., Inc. (in coop. with Am. Mus. Nat. History), 224 p., illus., table, 1967.

Pictures and an elementary text comprise the book, which is divided into five parts: the ever changing land; building and rebuilding (physical geology); the parade of life; treasures of our planet; and guides to discovery.—ESL

Ames, H. T. *See* Traverse, A. 04960

Anders, Edward. *See* Heymann, Dieter. 05398

05375 **Anderson, C. A.; Creasey, S. C.** Geologic map of the Mingus Mountain quadrangle, Yavapai County, Arizona: U.S. Geol. Survey Geol. Quad. Map GQ-715, scale 1:62,500, sections, 1967.

05165 **Anderson, Don L.** The anelasticity of the mantle, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 135–163, illus., tables, 1967.

Recent data on attenuation of body-waves, surface-waves, and free oscillations provide estimates of the anelasticity in various regions of the Earth. The upper mantle is more attenuating than the lower mantle, with maximum attenuation in the vicinity of the low-velocity zone; there is a rapid increase in attenuation in the vicinity of the C region, and compressional waves are less attenuated than shear waves. If attenuation in the mantle is due to an activated process it is probably controlled by the diffusion rate of defects at grain boundaries. If the lower mantle is homogeneous, the estimated activation volume is a small fraction of the presumed molal volume of its materials. Stress-induced migration of small point defects is a possible loss mechanism consistent with the observations.—DBV

05178 **Anderson, Don L.; O'Connell, R.** Viscosity of the Earth, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 287–295, illus., 1967.

Direct and indirect estimates of variation of viscosity with depth in the mantle indicate a low viscosity layer in the upper mantle. A viscosity varying with depth can be used to reconcile estimates of relaxation times. If seismic anelasticity can be used as a guide, average viscosity of the lower mantle is about 10^{23} P. Combined with previous estimates of upper mantle viscosity this gives a relaxation time of about 3,000 years for the non-equilibrium bulge of the Earth. This is close to the time from the last ice age but much less than the 10^7 years required if the non-equilibrium bulge is due to changing rate of rotation which requires an average mantle viscosity of 10^{26} P. If the latter value is correct, the activation volume for creep is much larger than for anelasticity, or the effect of a phase change in the upper mantle is more effective in suppressing creep than attenuation.—*from* Authors' summary

05188 **Anderson, Duwayne M.** Discussion—App. B *in* Saturation, phase composition and freezing point depression in a rigid soil model, by G. R. Lange and H. L. McKim: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 182, p. 15–18, illus., table, 1967.

Anderson concludes from equations dealing with freezing of soil water, as well as experiments on heat of freezing in Wyoming bentonites, that the heat of fusion of soil water must be somewhat lower than that of pure water. The difference will become larger, the lower the unfrozen soil water content. More experiments should be directed to verifying this conclusion, and if correct, to determining heat of fusion in representative soil water systems.—ESL

05070 **Anderson, G. M.; Burnham, C. Wayne.** Reactions of quartz and corundum with aqueous chloride and hydroxide solutions at high temperatures and pressures: Am. Jour. Sci., v. 265, no. 1, p. 12–27, 1967.

The solubilities of quartz in water and in aqueous solutions of HCl, KCl, NaCl, KOH, and NaOH have been determined by a weight-loss technique at 600°C, 3,000 bars and 700°C, 4,000 bars. Quartz solubility is decreased slightly from that in pure water by the addition of chlorides but increased by an amount directly proportional to the hydroxide concentration. Corundum solubility in pure water is too small (<0.1 weight percent) to be measured accurately by the method used but has been determined in KOH and NaOH solutions in the range 600°–900°C, 2,000–6,000 bars and found to be also directly proportional to the hydroxide concentration. Interpretation of the results indicates formation of uncharged alkali-

silica and alkali–alumina complexes with (Na, K)/Si and (Na, K)/Al ratios of 1/1 and 0.8 to 0.9/1 respectively.—Author's abstract

05265 **Anderson, Henry W.** Erosion and sedimentation, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 697–700, 1967.

This report summarizes work on laboratory studies of sediment transport, natural channel processes, sediment sources and erosional processes, and sediment measurements and instrumentation. A bibliography of pertinent works is given.—DBV

05075 **Anderson, W. I.** Conodonts from the Aplington Formation of northcentral Iowa: Iowa Acad. Sci. Proc. 1965, v. 72, p. 293–297, illus., table, 1967.

Conodonts comprising six species have been recovered from the Aplington Formation from five localities in northcentral Iowa. Although the Aplington conodont fauna is meager it suggests a correlation with the Maple Mill Shale of southeastern Iowa. The Aplington Formation is regarded as representing the youngest Devonian formation exposed in northcentral Iowa.—Author's abstract

05193 **Andrews, J. T.; Drapier, Lyn.** (compiler). Radiocarbn dates obtained through Geographical Branch field observations [with French abs.]: Canada Dept. Energy, Mines and Resources Geog. Br. Geog. Bull., v. 9, no. 2, p. 115–162, tables, 1967.

Radiocarbon dates are given for samples obtained, mainly in the Northwest Territories, by Geographical Branch research parties during the period 1950 to 1966.—Author's abstract

05124 **Anthony, L. M.** The discovery of the Keystone gold mine, Cleary Hill area, Fairbanks district, Alaska—A geochemical prospecting case history, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 3–12, 1967.

The Cleary Hill area in the Yukon–Tanana Upland, near Fairbanks, Alaska, was discovered by geochemical soil exploration using a general geochemical exploration technique for copper, lead, and zinc developed at the University of Alaska. The area selected by the prospectors for soil sampling was between two formerly productive but presently inactive gold properties. Analysis was done in situ by University of Alaska Method One, Modified; this procedure is described in detail. A promising geochemical soil anomaly was detected.—MST

05337 **Arnborg, Lennart; Walker, H. J.; Peippo, Johan.** Suspended load in the Colville River, Alaska, 1962: Geog. Annaler, v. 49A, nos. 2–4, p. 131–144, illus., tables, 1967.

Grain size, load per unit volume and total transport are considered as they vary both spatially and temporally. In 1962, load per unit volume increased at a more rapid rate than discharge such that the peak sediment load preceded peak discharge. Grain size varied positively with discharge although other variables, especially position of sampling point in relation to source area, caused local differences. Although the Colville River flows for over four months of the year, much of the discharge and suspended load transport occur during the first few weeks of the season, just preceding, accompanying, and immediately following breakup. Forty-three percent of the annual discharge and 73 percent of the total suspended inorganic load were carried oceanward during that period.—*from* Authors' abstract

05169 **Asmussen, Loris E.** Potential uses of flow net analysis in watershed engineering: Southeastern Geology, v. 8, no. 4, p. 195–204, illus., 1967.

Flow nets are graphical representations of flow patterns, and are a means of analyzing and interpreting the water table and piezometric maps. Factors to be considered and analyzed before a flow net is constructed for a watershed are: surface runoff from other watersheds with similar conditions, surface runoff from subwatersheds, geological conditions, ground-water conditions, and variations in ground-water elevation with time. After this is done, flow nets can be drawn which

will permit analysis of ground-water movement into, or from, the area. Flow nets were used to analyze the ground-water phase of the hydrologic cycle for the Meridian Formation, Marshall County, Mississippi.—*from* Author's abstract

Assad, R. *See* Kelly, R. W. 05102

05127 **Azzaria, L. M.** A method of determining traces of mercury in geologic materials, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 13-26, illus., tables, 1967.

The mercury halo method of mineral exploration has promoted the development of various methods for determining low mercury content of geologic materials. The present work deals with the properties of gold wool as a collector and emitter of traces of mercury, and the application of these properties to the determination of traces of mercury in geologic materials containing interfering substances. The sample is heated to vaporize all the mercury which is collected on gold wool while the interfering substances are exhausted. Next the gold is heated to volatilize the mercury which is measured with a mercury vapor meter.—MST

05173 **Baer, A. J.** Bella Coola and Laredo Sound map-areas, British Columbia: Canada Geol. Survey Paper 66-25, 13 p., geol. map, 1967.

The map-areas cross the Coast Mountains between latitudes 52° and 53° N., and are underlain mainly by plutonic rocks. In order of abundance, rocks are quartz diorite, granodiorite, quartz monzonite, diorite, gabbro, and granite; the age of most is unknown. Bands of schists and gneisses follow northwesterly trending belts within the plutonic rocks. Volcanic and metavolcanic rocks are abundant east of long 127° W. Fossils within the volcanic rocks indicate a Middle Jurassic age, but the age of the nonfossiliferous strata probably ranges from Early Jurassic to Late Cretaceous(?).—ESL

Baird, D. M. *See* Tuke, M. F. 05325

04913 **Barnes, Christopher R.** A questionable natural conodont assemblage from Middle Ordovician limestone, Ottawa, Canada: Jour. Paleontology, v. 41, no. 6, p. 1557-1560, illus., 1967.

Four conodonts belonging to the form-genus *Belodina* Ethington are fused together in what must have been essentially their original life position.—RCD

05249 **Barnes, Steven Solomon.** The formation of oceanic ferromanganese nodules [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1603B, 1967.

05202 **Barnett, D. M.** Glacial Lake McLean and its relationships with glacial Lake Naskaupi [with French abs.]: Canada Dept. Energy, Mines and Resources Geog. Br. Geog. Bull., v. 9, no. 2, p. 96-101, illus., table, 1967.

Five phases of glacial Lake McLean are outlined from field observations. Shoreline development, vertical spacing and size are compared with those of the Naskaupi glacial lakes in the adjacent George River basin. A series of ice barriers and overflow channels from the McLean lakes are mapped and discussed. The two lake systems remained discrete waterbodies but the higher phases of Lake McLean overflowed into the Naskaupi system.—Author's abstract

04999 **Bascom, Willard.** Mining in the sea, Chap. 10 *in* The law of the sea—Offshore boundaries and zones (Lewis M. Alexander, editor): [Columbus, Ohio] Ohio State Univ. Press, p. 160-171, 1967.

The growth of Ocean Science and Engineering, Inc. is reviewed and techniques in exploration for, and mining of diamonds, gold, tin, and heavy-mineral placers on the continental shelves of the world are discussed. The legal and political aspects are emphasized.—ESL

04949 **Bauer, A.; Fontanel, A.; Grau, G.** The application of optical filtering in coherent light to the study of aerial photographs of Greenland glaciers [with French and German abs.]: Jour. Glaciology, v. 6, no. 48, p. 781–793, illus., 1967.

The principles that underlie the analysis of aerial photographs using the coherent light from a laser are summarized, and then a study of such a filtering technique applied to an aerial photograph of Jakobshavn Isbrae is given as an example. Two systems of crevasses, respectively parallel and perpendicular to the direction of flow of the southern lobe of the glacier can be detected after filtering. These two crevasse systems were not apparent at first sight on the original photograph as they were obliterated by a network of curved crevasses. It appears that this latter network are not true crevasses, but surface undulations formed by differential ablation of bands of black (or blue) and white ice.—Authors' abstract

05174 **Bayne, Charles K.; Ward, John R.** (compilers). General availability of ground water in Kansas: Kansas Geol. Survey Map M–4, scale 1:500,000, 1967.

Bednar, Gene A. *See* Thomas, Chester E., Jr. 05344

Bednar, Gene A. *See* Thomas, Mendall P. 05345

05156 **Bell, Peter M.** Geophysical research at pressures above 30 kilobars, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 666–671, 1967.

Most of the report consists of an extensive bibliography of pertinent works (nearly 4 1/2 pages). Results of high pressure–temperature research since 1963 have tended to enlarge the focus of geologic attention to include the upper mantle in particular, and even more remote depths of the Earth. Symposiums on high pressure research have been popular. Phase equilibrium involving chemical reactions in the solid state predicted for the upper mantle have taken precedence, but there has been considerable work in the area of silicate melting temperature as a function of pressure. Shock wave experiments also have been carried out.—DBV

05266 **Bender, James A.** Snow and ice, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 728–729, 1967.

Studies in snow hydrology since 1963 have included some that are of geologic and geophysical interest, particularly on physical properties and deformation. A bibliography of pertinent works is given.—DBV

05213 **Bendix-Almgreen, Svend E.; Fristrup, Borge; Nichols, Robert L.** Notes on the geology and geomorphology of the Carey Öer, north-west Greenland: Medd. om Grønland, v. 164, no. 8, 19 p., illus., 1967.

Nordevestö, largest of the Carey Öer, is investigated. Precambrian gray, banded gneiss and pink gneiss predominate; dolerite dikes and sills also occur. Sedimentary rocks are found only as erratics, and they are similar to mainland rocks *in situ*. The island was covered by the main ice cap, although local ice may have occurred before and after the covering by the main sheet. The characteristic flat summits of the island and its neighbors are part of a late Pliocene or Pleistocene erosion surface which is on the mainland. The surface was heavily dissected fluvially after which it was submerged; the top of the surface makes up the islands. Raised beaches are found on the island as are numerous periglacial features such as frost cracks, solifluction lobes, frost mounds, frost-shattered rocks, talus, permafrost, and snowbank trimlines.—*from* Author's abstract

04954 **Benedict, James B.** Recent glacial history of an alpine area in the Colorado Front Range, U.S.A.—Pt. 1, Establishing a lichen-growth curve [with French and German abs.]: Jour. Glaciology, v. 6, no. 48, p. 817–832, illus., table, 1967.

A lichen-growth curve has been developed for dating Recent glacial and periglacial deposits in the Indian Peaks area of the Colorado Front Range. *Rhizocarpon geographicum* was selected because of its long life span and consistent size–age relationship. Growth rates were determined indirectly by measuring maximum

diameters of circular or nearly circular thalli growing on surfaces of known exposure and age. Measurements were made on 24 historically dated surfaces and on 3 radiocarbon-dated surfaces. Results indicate *R. geographicum* grows rapidly (14 mm/100 yr) during its first 100 years, then slows to an average rate of 3.3 mm/100 yr. The growth curve obtained is believed to be suitable for dating deposits at least as old as 3,000 yr.—*from* Author's abstract

04965 **Benelli, Gian Carlo.** Forecasting profitability of oil-exploration projects: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2228–2245, illus., tables, 1967.

Statistical application of historical success figures is to a large extent subjective. Data from one well known sedimentary basin cannot be safely extrapolated to another area where data are meager. Formulas for making economic evaluation of exploration areas are presented and discussed.—WLA

05186 **Berg, C. A.** A note on the mechanics of seismic faulting, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 89–99, illus., 1967.

An infinitely long shear crack in an infinitely deep elastic solid is considered as a model of a strike slip fault; friction on the faces of the crack increases linearly with depth. It is concluded that if a shear crack in the crust is to give rise to seismic shocks, the interaction between the crack faces must entail some cohesive strength, and if the crack is to continue to produce shocks while the loading on the Earth does not increase indefinitely, it must penetrate deeply enough into the crust to influence the compliance of the crust as a whole.—DBV

05406 **Berkey, E.; Fisher, D. E.** The abundance and distribution of chlorine in iron meteorites, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1543–1558, illus., table, 1967.

The abundance and distribution of chlorine in 13 iron meteorites has been studied by neutron activation analysis and metallographic examination. Terrestrial processes have affected the Cl in some finds and weathering can lead to severe contamination effects, raising the Cl content over certain localized regions by many orders of magnitude. The contamination process appears to act in conjunction with penetration of ground water into the interior through cleavages, grain boundaries, Neumann lines, and direct passage through the matrix. Measurements of primordial Cl in meteorites show that it is inhomogeneously distributed in the metal phase, being strongly depleted in kamacite and accumulating near grain boundaries, around inclusions, and in chloride minerals. Indications are that the higher primordial Cl content of previous data may be due to terrestrial contamination.—*from* Authors' abstract

04945 **Berner, Robert A.** Comparative dissolution characteristics of carbonate minerals in the presence and absence of aqueous magnesium ion: Am. Jour. Sci., v. 265, no. 1, p. 45–70, illus., tables, 1967.

Short term (5–25 hrs) steady state pH has been measured for the dissolution of reagent grade calcite, Deep Spring Lake dolomite, and Florida Bay sediment (aragonite plus 14 mode mole percent Mg calcite) in distilled water and 0.1 molal $MgCl_2$ solution at 25°C and constant $P_{carbon\ dioxide}$ (1 atm and $10^{-2.51}$ atm). Results indicate that calcite and dolomite can each show a constant ion activity product in the presence and absence of high concentrations of dissolved Mg^{++} if unground samples are used and steady state approached from undersaturation. Measured ion activity product values are: calcite, $10^{-8.37}$; dolomite, $10^{-17.0}$.—*from* Author's abstract

05049 **Berner, Robert A.** Thermodynamic stability of sedimentary iron sulfides: Am. Jour. Sci., v. 265, no. 9, p. 773–785, 1967.

Standard free energies of formation at 25°C of synthetic mackinawite ($\Delta F° = -22.3 \pm 0.1$ kcal/mole), synthetic greigite (-69.4 ± 0.7 kcal/mole) and freshly precipitated FeS (-21.3 ± 0.2 kcal/mole) are calculated from solubility equilibrium

constants in aqueous solutions saturated with H_2S, determined by pH measurements combined with analyses for dissolved iron. The solubility product of stoichiometric pyrrhotite and the first dissociation constant of H_2S in water are in good agreement with determinations by other methods. Mackinawite or greigite can be stable relative to each other in natural sediments but both are unstable relative to stoichiometric pyrrhotite with or without pyrite.—RWT

04968 **Beutner, Edward C.; Scholten, Robert.** Probable Cambrian strata in east-central Idaho and their paleotectonic significance: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2305–2311, illus., 1967.

Discovery of a thick sedimentary sequence of probable Cambrian age in east-central Idaho suggests the existence of a complete Cambrian geosyncline in the Rocky Mountains north of the eastern Snake River Plain, with a major tectonic and topographic high on its eastern flank.—WCC

05355 **Bhattacharyya, B. K.; Raychaudhuri, B.** Aeromagnetic and geological interpretation of a section of the Appalachian belt in Canada: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1015–1037, illus., 1967.

The area is bounded by lat 45° and 47°40′ N., and long 62°30′ and 67° W. Aeromagnetic data were filtered analytically to accentuate regional tectonic trend effects; second vertical derivatives were used. Bouguer anomaly results correspond well with the tectonic trends indicated by aeromagnetic data. Sixty-five anomalies were selected for evaluation. The pre-Carboniferous basement has a valley and ridge configuration, the blocks being bounded by faults. The blocks are aligned with the major trends of the area. A high magnetic intensity belt runs SE–NW over the Gulf of St. Lawrence and Prince Edward Island. This could be a pre-Taconic topographic high or a pre-Carboniferous basement high bounded by faults subparallel with those under the Cabot Strait.—*from* Authors' abstract

Biggs, W. P. *See* Morris, R. L. 04982

Billings, M. P. *See* Noble, D. C. 05270

Birrell, Pamela Jost. *See* Moore, Carleton B. 05378

05137 **Blackadar, R. G.** (editor). Report of activities—Pt. B, November 1966 to April 1967: Canada Geol. Survey Paper 67-1, pt. B, 92 p., illus., tables, 1967.

This report includes forty-one brief papers that describe research carried out by members of the Geological Survey of Canada between November 1966 and April 1967.—Author's abstract

05048 **Blagbrough, John W.; Breed William J.** Protalus ramparts on Navajo Mountain, southern Utah: Am. Jour. Sci., v. 265, no. 9, p. 759–772, illus., 1967.

Talus platforms composed of one to three protalus ramparts separated by ditches lie between 8,400 and 9,220 feet elevation, mostly on the south and southeastern side of Navajo Mountain. Six older platforms characterized by considerable masking vegetation, soil cover, and deeply weathered blocks comprising the protalus ramparts lie 20 to 200 feet below nine younger platforms characterized by unsubdued ramparts and freshness of blocks. The older platforms may be correlative with Wisconsin Bull Lake Glaciation and the younger with Pinedale Glaciation. The individual protalus ramparts probably developed during distinct periglacial stades.—RWT

05022 **Blais, Roger-A.** L'évaluation des réserves du gisement de fer de Baffinland à l'aide d'une calculatrice électronique [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 93, 1967.

05128 **Bloom, Harold.** The education of the applied geochemist—Will the university meet his need?, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 27–29, 1967.

A planned educational program in applied geochemistry, principally on the graduate level, would alleviate some of the problems in the fast growing field of applied geochemistry. An increase of properly trained geochemists can be of service in many areas (teaching, research, field practice) and provide a basis for a sound and continued advancement in the years ahead.—MST

05393 **Bodenstein, Frances.** Fossil corals as guides to the length of the Devonian year: Geol. Rev., v. 13, no. 1, p. 23–31, illus., 1967.

The regular banding on certain corals is believed to have a yearly, monthly, and even daily significance. Research has been done on epithecal ridges to determine the length of the Devonian year, as corals of this period are well-preserved. Wells (1963) has determined an average of nearly 400 daily bands for Devonian corals; whereas Scrutton (1966) has calculated the mean number of monthly bands to be 13. Thus paleontology can lend support to geophysical and astronomical theories. Ecologists question the cause of cyclical coral banding. Lunar breeding periodicity is a possibility, but more evidence is needed.—Author's abstract

05217 **Bogoch, Ronald.** Geology of the south half of Perron township, Abitibi-West county [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 561, 16 p., table, geol. maps, 1967.

All rocks are Precambrian, and include a volcanic assemblage, pyroclastic rocks, and narrow interbeds of metasedimentary rocks. The volcanic rocks are metamorphosed to greenschist facies. Sills of rhyolite, metadiabase, and epidiorite intrude dacites in the south, gabbroic plutons intrude the volcanic rocks, and a dioritic body is preserved as a roof pendant in the Patten River pluton in the west. The Mistawak batholith is exposed in the east. Diabase dikes cut all other rock types. Structural geology is discussed briefly. No significant mineral deposits have been found, but nine mineralized areas, and three mining properties are described.—ESL

Bond, D. C. *See* Buschbach, T. C. 05214

05255 **Bonham-Carter, Graeme Francis.** The geology of the Pennsylvanian sequence of the Blue Mountains, northern Ellesmere Island [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1572B, 1967.

05367 **Bonini, William E.** An evaluation of the resistivity and seismic refraction techniques in the search for Pleistocene channels in Delaware: Delaware Geol. Survey Rept. Inv. 11, 39 p., illus., tables, 1967.

It is difficult to find an interpretative resistivity layering that can be correlated with the lithology in Delaware where Pleistocene and pre-Pleistocene sediments are a variable mixture of sand, clay, gravel, and pebbles. Best results, in the Smyrna, New Castle, and Bear areas, were obtained with the horizontal resistivity traversing technique; correlation is between high resistivity values, usually 75,000 ohm-cm at spacings of 50, 75, and 100 feet, and either thick sections of sand and gravel, or near highly productive water wells. There is no conclusive evidence of difference in seismic velocity between Pleistocene and pre-Pleistocene sediments to depths of about 200 feet. It is concluded that the resistivity technique is a useful method under conditions of close well control.—*from* Author's conclusions

05368 **Bonini, William E.** (and others). The gravitational field and the shape of intrusive bodies: Princeton Univ. Geol. Eng. Rept. 67-3, 26 p., illus., 1967.

Gravitational field anomalies were observed in three Montana igneous intrusive areas: Boulder batholith, late Cretaceous quartz monzonite, 4,000 km^2; Little Rocky Mts., updomed area, 130 km^2, Eocene porphyry intruding Precambrian crystallines and Cambrian sediments; and Crazy Mts., Eocene diorite, 100 km^2, intruding Paleozoic and Mesozoic sediments. Anomalies of -40 and -28 mgal were found respectively for Boulder batholith and Little Rocky Mts., and +42 mgal for Crazy Mts. Analyses of the gravity anomalies predict: thickness of the Boulder batholith is 10–15 km and is concave upward; Little Rocky Mts. syenite is T-shaped and extends in depth to about 16 km; Crazy Mtn. diorite is not a simple series

of stocks but a large connected body extending in depth 5 km to basement.—*from* Authors' abstract

05256 **Boorman, Roy Slater.** Subsolvus studies in the system FeS–ZnS—O°–400°C [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1572B, 1967.

04903 **Bork, Kenneth B.; Perry, T. G.** Bryozoa (Ectoprocta) of Champlainian age (Middle Ordovician) from northwestern Illinois and adjacent parts of Iowa and Wisconsin—Pt. 1, *Amplexopora, Monotrypella, Hallopora, and Batostoma:* Jour. Paleontology, v. 41, no. 6, p. 1365–1392, illus., 1967.

Part of the bryozoan fauna from four limestone units of Champlainian age are identified and described. Statistical tests for comparisons of means were attempted, but because of the great structural variation, even within a single zoariam, the method was found unsatisfactory for taxonomic differentiation.—RCD

05129 **Boyle, R. W.** Geochemical prospecting—Retrospect and prospect, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 30–43, 1967.

Prospecting methods using chemical and biological techniques have been applied since early times, and today are assuming ever increasing importance in the search for mineral deposits. Their effectiveness has been proven in many geologic terranes and in a variety of climatic conditions. To improve the effectiveness of the methods, further detailed research in the nature and morphology of primary and secondary haloes is imperative. The methods now available should be sharpened for detection of large low grade deposits and for deposits buried by considerable thickness of overburden. More research in prospecting methods for detecting accumulations of oil and natural gas is warranted.—*from* Author's conclusions

Bradley, J. J. *See* Northwood, E. J. 05382

05135 **Bramlette, M. N.; Wilcoxon, J. A.** *Discoaster druggi* nom. nov. pro *Discoaster extensus* Bramlette and Wilcoxon, 1967, non Hay, 1967: Tulane Studies Geology, v. 5, no. 4, p. 220, 1967.

Discoaster druggi is here proposed as a replacement name for *D. extensus* Bramlette and Wilcoxon (ibid., v. 5, no. 3, p. 110, 1967), which is a homonym of *D. extensus* Hay (W. W. Hay and others, Gulf Coast Assoc. Geol. Socs. Trans., v. 17, p. 451, 1967). The original Bramlette paper is on middle Tertiary nannoplankton of Trinidad, and the Hay paper includes this area and stratigraphic range.—VMJ

Braslau, David. *See* Lieber, Paul. 05182

Bratt, Judy M. *See* Swain, Frederick M. 04914

Breed, William J. *See* Blagbrough, John W. 05048

Brennan, Peter A. *See* MacDonald, Harold C. 05304

Bridge, C. W. *See* Östrem, G. 05435

05354 **Bridgwater, D.** Feldspathic inclusions in the Gardar igneous rocks of South Greenland and their relevance to the formation of major anorthosites in the Canadian Shield: Canadian Jour. Earth Sci., v. 4, no. 6, p. 995–1014, illus., 1967.

Anorthosite inclusions represent a top accumulate of labradorite which developed at an early stage, and the megacrysts are feldspars that remained in suspension for a longer time, until the alkaline Gardar magma crystallized. Formation began 1,300 m.y. ago and continued to 1,200 m.y. The anorthosites formed just prior to the forming of the Grenville Belt and provide evidence for pre-Grenville, post Elsonian, non-orogenic anorthosite formation. The relative specific gravity of the plagioclase is the chief factor in formation of two types of anorthosites—those of layered intrusions and those of the Adirondack type. The separation of plagioclase by flotation explains why anorthosites can form unaccompanied by mafic layers. Such

monomineralic masses are very stable and survive later activity.—*from* Author's abstract

Brill, Kenneth G., Jr. *See* Gutschick, R. C. 04916

05363 **Brisbin, W. C.; Ediger, N. M.** (editors). A national system for storage and retrieval of geological data in Canada—Natl. Advisory Comm. Research in Geol. Sci., Rept. by *ad hoc* Comm.: Ottawa, Canada Geol. Survey, 175 p., illus., tables, 1967.

The national system for storage and retrieval of geologic data in Canada will consist of data files held and controlled by individual organizations; files within the system will be computer-based but oriented to requirements of the users; files will be linked by use of standard methods of recording reference numbers, geographic location, and of coding; the index to contents and location of data files will be a computer-assisted national index; and data will be recorded according to certain minimum standards, but may exceed them. Six appendices covering geological field data files, including the specification and operational manual; six covering mineral deposits tests; and eight covering geophysical data are included.—ESL

Brooker, E. W. *See* Sinclair, S. R. 05295

04898 **Brophy, Gerald P.; Foose, Richard M.; Shaw, Frederick C.; Szekely, Thomas S.** (leaders). Triassic geologic features in the Connecticut Valley near Amherst, Massachusetts, Trip D *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ. Dept. Geology] p. 61–72, illus., 1967.

Geologic history of the Connecticut Valley Lowland began in Triassic time when rift faulting produced a basin with highlands to the east. The fault scarps were buried by Triassic sediments. Volcanism during filling of the basin produced extensive flows and pyroclastics. Postvolcanic sediments contain plant and vertebrate fossils. Peneplanation of the region during Cretaceous time was followed by uplift during the Miocene, with downcutting to form the present valley, which was modified by Pleistocene glaciation and deposition of lake sediments. All these features are noted in a road log covering the area between Amherst and Holyoke. Several excellent, exposed geologic sections are observed.—VMJ

05130 **Brown, A. Sutherland.** Investigation of mercury dispersion haloes around mineral deposits in central British Columbia, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 72–83, illus., 1967.

Mercury profiles were compiled from soil samples collected from mercury localities along the Pinchi fault zone from Fort St. James to Kwanika Creek, and from molybdenum prospects of the Endako, Glacier Gulch, Lucky Ship, and Huber groups, north-central British Columbia. Secondary dispersion haloes were detected at all properties examined, although the order of anomaly peaks varied greatly from mercury to molybdenum deposits. Figures and profiles are included to show background variation and anomaly peaks for various metal deposits. In most localities background ranges from 0.01 to 0.1 ppm, but in others it is much higher.—MST

Brown, Alton R. *See* Logsdon, Truman. 05172

Brown, Harrison. *See* Nichiporuk, Walter. 05404

04976 **Bryan, J. H.** Engineering geology of the Millers Ferry Project: Eng. Geology, v. 4, no. 2, p. 1–13, illus., 1967.

Geologic conditions along the Alabama River, in the Gulf Coastal Plain near Millers Ferry, Alabama restricted the location of a lock, dam and powerhouse to a limited stretch of the river. The concrete structures are founded on a thin, gently-dipping rock stratum that is overlain by clay and underlain by an artesian zone. Subsurface conditions were explored by 121 core holes and two field pumping tests were conducted on the artesian zone to obtain data which was used in the design of

a relief well system. Foundation design and stability criteria were determined on the basis of laboratory tests of core samples. Further laboratory testing on cores drilled during the construction period indicate that design values were reasonable and conservative.—Author's abstract

04985 **Buckner, Guy O.** Film strip scanner for computer input, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. V1–V10, illus., 1967.

Electric logging data on an analog film strip is not in form for an electronic computer. This paper describes a magnetic ink analog film strip scanner. Although this method requires tracing over the desired curves with a magnetic ink ball point pen, undesired marks on the input film strip are eliminated. Four curves are provided for in the automatic operation of the scanner. Design and operation of the scanner are described with examples of use as an input device to an analog computer with recorded film strip output of input data and computed data. Examples are described.—*from* Author's abstract

05257 **Buffler, Richard Thurman.** The Browns Park Formation and its relationship to the late Tertiary geologic history of the Elkhead region, northwestern Colorado–south central Wyoming [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1573B, 1967.

04970 **Bull, C.; Corbato, C. E.; Zahn, J. C.** Gravity survey of the Serpent Mound area, southern Ohio: Ohio Jour. Sci., v. 67, no. 6, p. 359–371, illus., tables, 1967.

A closely-spaced network of gravity stations extending beyond the limits of the surface expression of the ring structure shows no gravity anomaly pattern that can be related to the surface features. Supporters of the astrobleme hypothesis are more likely to find this evidence useful than the cryptovolcanists. A cryptovolcanic structure could be associated with large lateral variations in density at the level of the basement, whereas the meteorite impact could produce shatter zones and brecciated layers, with a small reduction of density in the rock lying closer to the surface.—*from* Authors' abstract

04938 **Burchfiel, B. C.; Livingston, J. L.** Brevard zone compared to alpine root zones: Am. Jour. Sci., v. 265, no. 4, p. 241–256, illus., 1967.

The Brevard zone in the southern Appalachians appears to have the characteristics of the linear root zones described from the Alps. If rocks of the Blue Ridge are allochthonous in the area of the Grandfather Mountain window, then the Brevard zone would be a root zone, along which considerable shortening, squeezing, and downward movement of crustal material has occurred. All linear belts that are parallel or sub-parallel to orogenic structural trends need not be strike-slip faults; some of them may be root zones of the type described here. Because of later faulting within root zones, the two types of linear structures may look quite similar. At present the only reliable characteristic to differentiate them is independent evidence that nappes root into them.—*from* Authors' abstract

05319 **Burnett, D. S.; Wasserburg, G. J.** Rb-87/Sr-87 ages of silicate inclusions in iron meteorites: Earth and Planetary Sci. Letters, v. 2, no. 5, p. 397–408, illus., tables, 1967.

Rb-Sr measurements were made on silicate inclusions extracted from the iron meteorites Toluca, Odessa, Four Corners, Linwood, Pine River, Colomera and Weekeroo Station. Strontium isotopic analyses were made on samples as small as 24 mg. The typical Sr and Rb blanks were 2×10^{-9}g and 2×10^{-10}g, respectively. In certain cases it was possible to obtain relatively precise isochrons. With the exception of Colomera, all of these samples gave ages compatible with 4.4 to 4.8×10^{9} y. The Colomera data scatter widely and do not meet the requirements for defining a reliable age. None of the samples are compatible with an age of 6×10^{9} y. The primary strontium observed or estimated for Toluca and Pine River agrees with that obtained from achondrites. It is evident that extensive Rb-Sr isotopic studies may be made on a large number of rather typical iron meteorites.—Authors' abstract

Burnham, C. Wayne. *See* Anderson, G. M. 05070

05214 **Buschbach, T. C.; Bond, D. C.** Underground storage of natural gas in Illinois—1967: Illinois Geol. Survey Illinois Petroleum 86, 54 p., illus., tables, 1967.

Natural gas is stored in underground reservoirs at 22 locations in Illinois; these reservoirs contain 200 billion cubic feet of gas, about half of which is working gas and half is cushion gas. Potential capacity of the reservoirs is estimated to be 600 billion cubic feet. At eight of the storage projects, gas is stored in depleted gas reservoirs; in the remaining 14 projects, it is stored in aquifers that originally contained no hydrocarbons in commercial quantities. All systems of rocks from Cambrian to Pennsylvanian are used for storage; most of the volume, however, is in sandstone aquifers of Cambrian-Ordovician age. A brief discussion of some of the technology associated with underground storage of gas is included, also information on the geologic setting and history of development of each project.—*from* Authors' abstract

05407 **Buseck, Peter R.** The post-formational history of a hypersthene chondrite Beenham, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1583–1587, illus., table, 1967.

The Beenham meteorite contains native copper and ilmenite in addition to the common minerals characteristic of the hypersthene chondrites. The metal contains Neumann lamellae, some greatly deformed, as well as areas of apparent flowage. The troilite is a relatively late phase, having replaced kamacite within plessitic intergrowths. Troilite locally displays twin lamellae. Elsewhere it is in braided veinlets and in globules, both reflecting former melting. These varied textures indicate a complex history encompassing several deformational events, presumably due to parent body impacts and perhaps breakups.—Author's abstract

05423 **Buseck, Peter R.; Moore, Carleton B.; Goldstein, Joseph I.** Marburg—A new pallasite, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1589–1593, illus., table, 1967.

A new meteorite, found at Marburg, Hesse, Germany, is described. It contains well-rounded olivine crystals having a composition of 12.5 mole percent fayalite. Neither compositional variation between crystals, nor zoning within the olivine crystals could be detected. The average of two compositional determinations of the metal phase is: Fe—88.4, Ni—11.02, Co—0.51, P—0.005, S—0.028 wt. percent and Ga—19 ppm. A modal analysis indicated the following approximate composition (wt. percent): metal—63, olivine—35, and combined troilite and schreibersite—2, with troilite predominating. The cooling rate, determined on the metal phase, is 0.8°C per 10^6 yr. The Marburg pallasite appears to be typical of this rare and interesting group of meteorites.—Authors' abstract

05338 **Cailleux, André.** Actions du vent et du froid entre le Yukon et Anchorage, Alaska [with English abs.]: Geog. Annaler, v. 49A, nos. 2–4, p. 145–154, illus., 1967.

Observations on the influence of wind and frost action made during the INQUA field trip in Alaska in 1965, are reported, discussed and compared with examples from other areas. Among the features discussed are: tor-like rocks, products of mechanical disintegration, nivation benches, V- or U-shaped gullies, solifluxion lobes, pingos, palsas, round or oval ponds, cave-in lakes, thermokarst mounds, thermosuffusion forms, thermodolines, thin cracks in frozen loess or sand, secondary deposits of $CaCO_3$, MnO_2 and $Fe(OH)_3$.—Author's abstract

04978 **Callison, J. C.; Roth, J. N.** Construction geology of the West Coast Basin Barrier Project: Eng. Geology, v. 4, no. 2, p. 42–53, illus., 1967.

The coastal margin of the West Coast Ground Water Basin in Los Angeles County, Calif., is underlain by fresh-water-bearing Pleistocene clastic rocks. Two primary aquifers, the Silverado and Lower San Pedro, are engulfed by aquicludes. In 1953, wells drilled into these were used to inject fresh water under pressure in order to build up a pressure barrier to prevent salt-water encroachment. Since then, more,

and larger wells have been installed along an alignment roughly parallel to the coast line from 0.5 miles to 1.2 miles inland. An elongate pressure ridge has been built up as much as 25 feet over pre-barrier levels. Careful control is maintained to keep the sea-water fresh-water contact at equilibrium and to use the pressure for fresh water supplies also. Engineering factors are discussed.—*from* Authors' abstract

Calvin, Melvin. *See* McCarthy, Eugene D. 05269

05123 **Cameron, E. M.** (editor). Symposium on geochemical prospecting, Ottawa, 1966, proceedings: Canada Geol. Survey Paper 66-54, 282 p., illus., tables, 1967.

This symposium, sponsored by the National Advisory Committee on Research in the Geological Sciences, was held from April 20-22, 1966. Its contributions were concerned almost entirely with the application of geochemical methods to exploration for metallic mineral deposits. This volume contains the papers of those authors who desired publication and submitted manuscripts prior to September 1, 1966; 17 papers and 16 abstracts are cited separately.—MST

Campbell, A. T., Jr. *See* Lebourg, M. 04989

05258 **Campbell, John Arthur.** Devonian system of west central Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1573B, 1967.

05372 **Canada Dept.Energy,Mines,Resources.** Principal mineral areas of Canada: Canada Geol. Survey Map 900A, 17th edition, scale 1:7,603,200, 1967.

The map sheet includes an index to principal producing areas with names of operating companies as of January 1967; a graph of mineral production for 1966 of metallic minerals, fuels, industrial minerals, and construction materials; a table showing production by provinces for 1966; a graph indicating mineral production in dollars per capita from 1946 to 1966; and an index to principal oil and gas fields as of January 1967.—MCM

Canis, Wayne F. *See* Gutschick, R. C. 04916

05095 **Canney, F. C.** Hydrous manganese-iron oxide scavenging—Its effect on stream sediment surveys [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 267, 1967.

05096 **Canney, F. C.; Erickson, R. L.** Geochemical prospecting research by the United States Geological Survey [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 268, 1967.

04958 **Carmichael, R. S.; Fuller, M. D.** Effect of plastic deformation on magnetic properties of nickel and interpretation of an early self-reversal of magnetization observed by Nagaoka: Jour. Geomagnetism and Geoelectricity, v. 19, no. 3, p. 181-193, illus., 1967.

The mechanical hardening or softening in a polycrystalline nickel rod subjected to torsional plastic deformation is found to be accompanied by magnetic hardening or softening. In the presence of a magnetic field, a remanent magnetization component is acquired which depends upon magnitude of the field and extent of deformation. The self-reversal of magnetization in a nickel wire reported by Nagaoka (1888) can be explained in the light of these experiments; it is shown that magnetic effects accompanying reverse loading are related to changes in internal stress state of the rods. It is suggested that results can be extended to magnetite in the deformation zone of the Earth's upper crust.—VSN

Carpenter, B. *See* Schmidt, A. W. 04991

Carter, Claire. *See* Cobb, Edward H. 00024

05264 **Carter, Neville L.** Impact and impactites, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 693-696, 1967.

Significant advances have been made since 1963 in the following areas: (1) physical characteristics and deformation mechanics in rocks and minerals deformed by shock due to meteorite impact; (2) effects of nuclear explosions, experimental shock wave compression, and hypervelocity impacts of projectiles on rocks; and (3) origin of diamonds in meteorites. This report comments briefly on the highlights of each of these topics. A bibliography of pertinent works is given.—DBV

04937 **Cassidy, Martin.** (compiler). Massachusetts bibliography of B. K. Emerson, *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ., Dept. Geology] p. 4–6, reprinted in part, 1967; originally published 1962.

Caufield, K. *See* Harrison, W. W. 05171

05221 **Chaffee, Maurice Ahlborn.** A study of the geology and hydrothermal alteration north of the Creede mining district, Mineral, Hinsdale, and Saguache Counties, Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1574B, 1967.

Chamney, T. Potter. *See* Russell, Dale A. 05216

05222 **Chan, Samuel Shu Mou.** Mineralogical and geochemical studies of the vein materials from the Galena mine, Shoshone County, Idaho [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1574B, 1967.

Charette, J.-P. *See* Gold, D. P. 05116

05388 **Chave, Keith E.; Suess, Erwin.** Suspended minerals in seawater: New York Acad. Sci. Trans., ser. 2, v. 29, no. 8, p. 991–1000, illus., tables, 1967.

Surface water samples from the Bermuda platform, south coast of Jamaica, Cedar Key, Fla., and southern Caribbean Sea, almost all supersaturated with calcite and aragonite, were observed for inorganic chemical interactions between suspended carbonate minerals and sea water. It was found that no interaction took place, and that the mineral particles were isolated from the water by organic coatings. Experiments in which 13 to 1,300 mg of reagent calcite was added to 100 ml of sea water of pH 8.22 showed that the surface of up to 300 mg of calcite was coated rapidly by adsorption of dissolved organic molecules, blocking inorganic reaction; with 500 and 700 mg, reaction was partially inhibited by coating; with 1,000 and 1,300 mg of calcite, uninhibited equilibration occurred, the uncoated surface being large enough that normal solution kinetics controlled the rate of reaction.—VMJ

05191 **Chen, Albert T. F.** Plane strain and axisymmetric primary consolidation of saturated clays [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1489B, 1967.

Chen, J. T. *See* Sherif, M. A. 05376

Chodos, Arthur. *See* Nichiporuk, Walter. 05404

00015 **Christensen, Nikolas I.** Compressional wave velocities in basic rocks: Pacific Sci., v. 22, no. 1, p. 41–44, illus., tables, 1968.

Compressional wave velocities determined by measurement of traveltimes of pulses at pressures to 10 kilobars are given for specimens of basalt. Variations of velocity with propagation direction are related to feldspar orientation and inhomogeneity in alteration of the specimens. Velocity differences reported for diabase, gabbro, eclogite, and basalt can be explained in terms of variation of density and mean atomic weight. The basalts have the lowest compressional wave velocities of basic rocks. The low velocities are a consequence of slight alteration, high mean atomic weight, and relatively low density.—Author's abstract

Clabaugh, Patricia S. *See* Spencer, Alexander B. 05051

Clark, A. R. *See* Schwerdtner, W. M. 05353

05421 **Clark, R. S.; Rowe, M. W.; Ganapathy, R.; Kuroda, P. K.** Iodine, uranium and tellurium contents in meteorites, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1605–1613, tables, 1967.

The abundance of iodine, uranium and tellurium were determined in 15 achondrites, 5 chondrites (2 with light–dark structure) and 3 mesosiderites by neutron activation analysis. In 30 analyses on achondrites the following range of abundances was found: I, 14 ppb–1 ppm; U, 2–210 ppb; and Te, $\leq$0.03–3 ppm. These elements vary within a given class of achondrites, and the individual achondrites show a higher degree of heterogeneity than the chondrites. The iodine content of achondrites is of the same order as in chondrites. Uranium contents range higher and tellurium lower in achondrites than in chondrites. Weaker correlation between iodine and tellurium is observed in achondrites than in chondrites.—Authors' abstract

05097 **Clews, D. R.** Geochemical prospecting procedures, theory and practice [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 269, 1967.

00024 **Cobb, Edward H.; Wanek, Alexander A.; Grantz, Arthur; Carter, Claire.** Summary report on the geology and mineral resources of the Bering Sea, Bogoslof, Simeonof, Semidi, Tuxedni, St. Lazaria, Hazy Islands, and Forrester Island National Wildlife Refuges, Alaska: U.S. Geol. Survey Bull. 1260–K, p. K1–K28, illus., 1968.

Islands that constitute the Bering Sea, Bogoslof, Forrester Island, St. Lazaria, Semidi, and Simeonof refuges are made up mainly of igneous rocks; Hazy Islands are sedimentary and metamorphic rocks, and sedimentary rocks of Jurassic age underlie the Tuxedni refuge. None of the areas contains known deposits of either leasable minerals or minerals subject to location under U.S. mining laws. Test wells drilled at Oil Bay had numerous oil and gas shows in rocks of the Tuxedni Group, but there has been no commercial production. On Chisik Island the absence of favorable structures and the fact that reservoir rocks are at the surface preclude favorable possibilities. No mineral production is known and the mineral potential is poor.—*from* Authors' abstract

05080 **Coble, Ronald W.** The effects of the Alaskan earthquake of March 27, 1964, on ground water in Iowa: Iowa Acad. Sci. Proc. 1965, v. 72, p. 323–332, illus., table, 1967.

The large Alaskan earthquake of March 27, 1964, affected all the major aquifers in Iowa. The effects included (1) seismic fluctuations of the water level; (2) turbid water; and (3) a permanent change in some water levels. A change in the porosity of the aquifers is postulated as an explanation for the permanent water-level changes.—Author's abstract

04957 **Coe, Robert S.** The determination of paleo-intensities of the Earth's magnetic field with emphasis on mechanisms which could cause non-ideal behavior in Thellier's method: Jour. Geomagnetism and Geoelectricity, v. 19, no. 3, p. 157–179, illus., 1967.

Possible causes are considered for deviations of NRM–TRM curves, determined by Thellier's method on numerous samples of volcanic rocks, from a straight line over parts of their lengths. Mechanisms examined (sample demagnetizing field effects, secondary components of magnetization, mechanisms of acquisition of TRM which violate Thellier's assumptions, changes in TRM spectrum induced by laboratory heating, and others) are discussed theoretically and experimentally, and effects are identified in the curves. No adequate diagnostic tests were found to indicate quickly the suitability of a rock for intensity studies. The method of comparing NRM and total TRM to obtain paleo-intensities may be more useful than Thellier's method for obtaining average values of paleo-intensity during geologic periods from suites of volcanic rocks.—VSN

05046 **Cohen, Lewis H.; Ito, Keisuke; Kennedy, George C.** Melting and phase relations in an anhydrous basalt to 40 kilobars: Am. Jour. Sci., v. 265, no. 6, p. 475–518, illus., tables, 1967.

Anhydrous basalt glass, similar in composition to average Pacific Ocean tholeiite, was recrystallized under a range of pressures and temperatures and the liquidus, solidus, and sequence of phases determined. Data from synthetic and natural basalt systems show that the lowest pressure at which garnet appears near the solidus of basaltic assemblages is probably 15–16 kilobars for basalt with a wide range of composition, but that the pressure at which feldspar disappears is more variable. No reliable data were obtained for the subsolidus bandwidth or slope of the basalt-eclogite transition region. The 3–4 kilobar transition zone found at solidus is large compared to some seismological estimates of the bandwidth of the Mohorovicic discontinuity.—*from* Authors' abstract

05411 **Cole, A. J.; Jordan, C.; Merriam, D. F.** FORTRAN II program for progressive linear fit of surfaces on a quadratic base using an IBM 1620 computer: Kansas Geol. Survey Computer Contr. 15, 53 p., illus., tables, 1967.

Two pages of text include an introduction, description of the program, and contouring procedure. Lead cards, data card, trailer cards, and error messages are followed by a listing of the progressive linear-fit trend-surface program. Table two gives data for a sample problem—structure on top of the Pennsylvanian Lansing Group in south-central Kansas. The computer-drawn map shows a good approximation of regional structure as shown on a hand-drawn map, although more generalized. Table three gives output for data shown in table two, and table four is optional output.—ESL

Coleman, J. M. *See* Smith, W. G. 05067

Coleman, Robert G. *See* Peterman, Zell E. 05314

Colton, Roger B. *See* Hartshorn, Joseph H. 04917

04940 **Cook, Kenneth L.; Hardman, Elwood.** Regional gravity survey of the Hurricane fault area and Iron Springs district, Utah: Geol. Soc. America Bull., v. 78, no. 9, p. 1063–1076, illus., 1967.

A Bouguer gravity anomaly map with a contour interval of 2 mgal is constructed from 660 stations taken over an area of about 1,900 sq mi. The gravity patterns confirm intersection of the Virgin–Kanarra fold by the Hurricane and Washington faults. The gravity data indicate several known and previously unknown Basin and Range faults or fault zones that bound grabens and horsts. An extensive gravity high over the Iron Springs district indicates that the four outcropping intrusions of quartz monzonite porphyry are probably continuous at relatively shallow depth.—AG

05297 **Coon, Lester A.** Memorial to Richard Freed (1908–1967): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2313, portrait, 1967.

05281 **Coons, Richard L.; Woollard, George P.; Hershey, Garland.** Structural significance and analysis of Mid-Continent gravity high: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2381–2399, illus., 1967.

The Mid-Continent gravity high is a large gravity anomaly which extends from Lake Superior to Oklahoma, and occupies the center of a 300 mile wide fault system which crosses the center of the North American continent. This basement feature can be related to Keweenawan faults and intrusives near Lake Superior. Throughout the Paleozoic Era movement continued along these faults, resulting in several anomalies that were mapped in Kansas, Nebraska, Iowa, and Minnesota. A new technique of gravity analysis involving the fitting of nonorthogonal polynomial surfaces to gravity data is particularly applicable to the study of basement geology as delineated by gravity measurements. The polynomial analysis shows a detailed correlation of the gravity residuals with both basement geology and Paleozoic structure.—*from* Authors' abstract

Cöope, J. A. *See* Gleeson, C. F. 05120

Corbato, C. E. *See* Bull, C. 04970

Cotterell, C. H. *See* Evans, Hilton B. 04983

05154 **Cox, Allan.** Paleomagnetism, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 525–528, 1967.

The main developments in paleomagnetism in 1963–67 include the belated beginning of United States research in archeomagnetism and paleointensity, development of a time scale for geomagnetic reversals based on K–Ar dating of volcanic rocks, and application of this time scale to problems of oceanography. Research has continued on paleomagnetism as related to global tectonics and on the physics of rock magnetism. A bibliography of pertinent works is given.—DBV

Creasey, S. C. *See* Anderson, C. A. 05375

05033 **Crickmay, C. H.** A note on the term bocanne: Am. Jour. Sci., v. 265, no. 7, p. 626–627, 1967.

A bocanne is a shale outcrop undergoing combustion. The process seems to begin at the surface, spreads without flame in beds containing combustible ingredients, and leaves behind brick-colored shale or clay.—DLD

05177 **Crittenden, Max D., Jr.** Viscosity and finite strength of the mantle as determined from water and ice loads, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 261–279, illus., tables, 1967.

Some recent examples of transient Earth loads (Lake Bonneville, Utah; Glacier Bay, Alaska; northeastern Greenland) indicate that both the viscosity and finite strength of the mantle are lower than is commonly presumed. A time constant (1/e) of 4,000 years is estimated for Lake Bonneville, and 1,000 years for northeast Greenland. A strain rate of 10^{-14} is typical. These figures imply viscosities in a homogeneous half space ranging from 10^{20} to 10^{21} poises. An upper limit of finite strength is set by Lake Bonneville at a few times 10^{6} dyn per cm^2. If mountain ranges like the Sierra Nevada or Himalaya are regarded as dynamically supported rather than static systems, this low value is not incompatible with other geologic observations.—Author's summary

05422 **Crocket, J. H.; Keays, R. R.; Hsieh, S.** Precious metal abundances in some carbonaceous and enstatite chondrites, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1615–1623, illus., tables, 1967.

Neutron activation analysis has been used to determine the concentrations of Ru, Pd, Os, Ir, Pt and Au in seven carbonaceous and two enstatite chondrites. The average atomic abundances relative to 10^{6} silicon atoms are tabulated. The data are compared with previously published precious metal values for olivine bronzite and olivine hypersthene chondrites. Abundances in olivine bronzite and carbonaceous chondrites are generally comparable except for Ir which is lower in the former. Both enstatite and olivine hypersthene chondrites have lower atomic abundances than carbonaceous chondrites except for Au in the enstatite chondrites. The average depletion of precious metals in the olivine hypersthene chondrites relative to the carbonaceous chondrites is approximately 40 percent.—*from* Authors' abstract

Crooks, James W. *See* Stuart, Wilbur T. 05290

05223 **Crosby, Gary Wayne.** Structural evolution of the Middlebury synclinorium, west-central Vermont [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1575B, 1967.

Cross, Christine H. *See* Warren, Harry V. 05094

Cross, Christine H. *See* Warren, Harry V. 05361

05208 **Cushman, George C.; Stevenson, Robert E.** Simulating marine coring procedures in sedimentary rocks [abs.]: South Dakota Acad. Sci. Proc. 1967, v. 46, p. 244, 1967.

05301 **Dahlgren, E. G.** Memorial to George O. Williams (1897–1967): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2316–2317, portrait, 1967.

05011 **David, Peter P.** Les grandes dunes de la Saskatchewan [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 95, 1967.

05285 **Davis, Richard A., Jr.** Paleocurrents and shoreline orientations in Green River Formation (Eocene), Raven Ridge and Red Wash areas, northeastern Uinta Basin—Discussion [of paper by M. D. Picard, 1967]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2470–2471, 1967.

Symmetrical ripple marks as used by Picard (ibid., v. 51, p. 383–392, 1967) are unsuitable for paleogeomorphic reconstructions.—WCC

05190 **Davis, Richard Warren.** A geophysical investigation of hydrologic boundaries in the Tucson Basin, Pima County, Arizona [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1586B, 1967.

05126 **Debham, A. H.** The atomic absorption spectrometer in the geochemical laboratory, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 84–88, table, 1967.

In recent years a new analytical procedure, atomic absorption spectrophotometry, has been developed for rapid semi-quantitative analysis in geochemical studies. The method has most of the advantages of both colorimetry and spectrography with very few disadvantages, and is applied to solution extracts of samples; it is rapid, precise, sensitive, and free of interference. The theory of atomic absorption is discussed, as well as atomic absorption instruments and their operation.—MST

05139 **Decker, Robert W.** Investigations at active volcanoes, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 639–647, tables, 1967.

The Hawaii Volcano Observatory continues to be the principal United States research center on active volcanism. Flank eruptions of Kilauea occurred on August 21–23 and October 5–6 in 1963 and on March 5–15 and December 24–25 in 1965. Alaskan volcanoes are more numerous, more explosive, and more unknown. Confirmed eruptions of Amukta, Augustine, Trident (twice), Westdahl Peak, Redoubt (twice), Pavlov, and Shishaldin occurred. Relatively few investigations were made in the Cascade Range in 1963–67. The theory that some of the features on the Moon are of volcanic origin has been supported by photographic and soft-landing Moon rockets. Interesting studies on volcanism in general are developing. An extensive bibliography is given.—DBV

Delavault, Robert E. *See* Warren, Harry V. 05094

Delavault, Robert E. *See* Warren, Harry V. 05361

Dellwig, Louis F. *See* MacDonald, Harold C. 05304

Denison, Rodger E. *See* Muehlberger, William R. 05302

Dennen, William H. *See* Post, Edwin V. 05291

Denton, George H. *See* Porter, Stephen C. 05041

05441 **Derrey, François.** Our unknown earth (translated from the French by Gregor Roy): New York, Stein and Day, 272 p., illus., 1967; originally published 1964.

Is the Earth alive?, a preface by Jean Lombard, stresses the structural similarity between the living and mineral worlds. The first five chapters cover myths, legends, and primitive concepts of the Earth, early philosophers and opponents of Galileo, and fantastic concepts of the Earth. Other chapter headings are: enigma of glaciers and catastrophism, lesson of the flood, search for Atlantis, great cataclysms, Earth in the universe, motions of the Earth, fast-aging planet (origin of Earth, its age, and origin of life), shape and size of the Earth, life in the inner depths, earthquakes and volcanoes, world in transformation (includes shields, continental fracture systems, orogenies, and oceanic ridge), terrestrial magnetism, continents' great adventure (drift), the atmosphere, planet of life, and man's assault upon the Earth.—ESL

04986 **Desai, K. P.; Moore, E. J.** Well log interpretation in permafrost, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. N1–N27, illus., table, 1967.

Permafrost or permanently frozen ground covers a large portion of the arctic sedimentary basins of Canada and Alaska; the thickness of the layer varies up to a maximum of 1300 feet. Some accumulations of hydrocarbons in permafrost have been reported. This paper describes a method for establishing temperature distribution around a well bore in these surroundings, and discusses the basic borehole environments which might occur under a variety of drilling and completion programs. Laboratory-determined data is presented to show the effects of below freezing temperatures upon fluid and rock properties, and an interpretation from actual field logs is given. It is concluded that a knowledge of physical properties of permafrost, its temperature distribution, and proper field procedures are all important to a quantitative interpretation of well logs in permafrost.—*from* Authors' abstract

Deutsch, E. R. *See* Lilly, H. D. 05039

05343 **Deutsch, E. R.; Roy, J. L.; Murthy, G. S.** An improved astatic magnetometer for paleomagnetism: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1270–1273, illus., table, 1967.

The advent of new materials, the products of ceramic barium ferrite, has resulted in magnets which can be magnetized transversely, and as such, be used to make magnetometers far more sensitive than have heretofore existed. Examples are given in the form of a table comparing the various parameters of astatic magnetometers which now exist and those which are theoretically possible with the new materials. The sensitivities are increased appreciably.—HRC

05038 **Dietz, Robert S.** Passive continents, spreading sea floors and continental rises—A reply [to discussion by G. M. Young, 1967]: Am. Jour. Sci., v. 265, no. 3, p. 231–237, 1967.

Dietz replies to each of Young's criticisms (ibid., p. 225–230, 1967) as to multiple orogenies, the presence of simatic basements beneath eugeosynclines, accretion of North America (younger crystalline Appalachian orogen is cited as an example), accretion and continental drift, and the assumption of universal sialic crust and intracratonic geosynclines. He reaffirms his adherence to actualism and uniformitarianism, and comments that the usual ensialic geosynclinal theories ignore the basic dichotomy of the Earth into sialic and simatic segments and ignore the presence of the continental slope, the great scarp connecting these realms.—VSN

05098 **Dimroth, E.** Stream sediment sampling during traverse mapping [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 269–270, 1967.

05329 **Dineley, David L.** Ancient fishes of Escuminac Bay: Nat. History, v. 76, no. 1, p. 40–45, illus., 1967.

On the north shore of Escuminac Bay, between Fleurant Point and Miguasha, Quebec, the Late Devonian Escuminac Formation furnishes an unusually complete view of a fresh-water lake fauna. These are comparable to fossils found in the

Old Red Sandstone of Greenland and Europe. Two fossils were among the last of the ostracoderms. Acanthodians and placoderms are found also, several of which are described and pictured. The fauna includes a species of rayfin, and crossopterygian fish are well represented. Two genera of lungfish not found elsewhere are compared to modern forms.—ESL

05004 **Dionne, Jean-Claude.** Sédimentologie littorale et glaciel [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 100, 1967.

05012 **Dionne, Jean-Claude.** Modelé périglaciaire de la région de Mont-Joli, Québec [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 96, 1965.

05018 **Dionne, Jean-Claude.** Formes littorales de corrosion et de dissolution sur la rive sud de l'estuaire du Saint-Laurent [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 98-99, 1967.

Disteche, A. *See* Pytkowicz, R. M. 05313

Disteche, S. *See* Pytkowicz, R. M. 05313

Dobrovolny, Ernest. *See* MacQuown, William C., Jr. 00031

04933 **Dodd, J. Robert.** Magnesium and strontium in calcareous skeletons—A review: Jour. Paleontology, v. 41, no. 6, p. 1313-1329, illus., 1967.

Trace and minor elements of skeletal carbonate materials may be included in the skeleton in the following forms: 1, substitutes for calcium in the calcite or aragonite crystal lattice; 2, constituents of separate mineral phases; 3, surface adsorbed elements; or 4, constituents of organic compounds. The concentration of magnesium and strontium in carbonate skeletons is controlled by four major factors: water chemistry, other environmental factors, mineralogy, and physiology of the organisms. In general, the phylogenetically more advanced forms have lower Mg and Sr values. Skeletal chemistry may also vary between genera and families within a given major group. The mechanisms of physiological control of Mg and Sr are not understood but "isolation" of the calcification site and growth rate may be involved.—*from* Author's abstract

Dodd, John D. *See* Webster, Ruth M. 05071

05224 **Dodge, Charles Fremont, 3d.** Microstratigraphy of the channel sandstones of the Woodbine Formation, Tarrant County, Texas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1575B, 1967.

05262 **Doe, Bruce R.; Marvin, Richard F.** Radioactive and radiogenic isotope research in North America, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 672-686, 1967.

Most of this report is the extensive bibliography (11 pages), which is believed to be more than 90 percent complete. A large number of superb papers have been published since 1963 that illustrate the principles of geochronology and effect of geologic events on the isotopes used to determine ages. The trend in geochemistry is now toward closely integrated and increasingly more detailed laboratory and field studies involving large numbers of samples and several dating methods. The technical emphasis has been on whole rock Rb-Sr dating. The source of basalts and silicic rocks has been sought by measuring their Sr and Pb isotopes; it appears that the upper mantle is not uniform in terms of Sr and Pb isotopic composition. Discovery of U-234/U-238 inequilibrium in the incipiently weathered zone of a granite provides an excellent tracer in the weathering zone most difficult to recognize.—DBV

Don, Nguyen. *See* Ladanyi, B. 05294

05195 **Donahue, B. A.; Leonard, J. W.** Petrography for mining and coal preparation, Pt. 2: Soc. Mining Engineers Trans., v. 238, no. 4, p. 360-365, illus., 1967.

Results of research are presented examining the extent to which the analytical characteristics of the relatively distinct coal bands from a variety of coal seams can be related to each other. This paper discusses an approach for developing a practical coal petrographic quality control program based on conventional analyses, most of which is part of the standard A.S.T.M. procedure. The work is a final follow-up to Part 1 of this series which was prepared by the authors as an approach to applying conventional coal petrography to single coal seams.—Authors' abstract

05346 **Donaldson, J. A.** Precambrian vermiform structures—A new interpretation: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1273–1276, illus., 1967.

Spindle and rod shaped structures from Huronian rocks in Michigan and Ontario have, in the past, been considered as possible metazoan fossils. Observations of some structures formed penecontemporaneously in a modern fresh-water environment indicate that several features characteristic of the problematic Precambrian structures may be simulated by algal mats subjected to subaerial dessication, and thus another possible origin for these Precambrian structures is possible. Illustrations show the origin of the algal mats and the similarity to the structures in the Precambrian. Recent studies of the Proterozoic Dubawnt Group in the Northwest Territories have revealed similar rod and spindle-shaped structures.—HRC

05005 **Dorion-Robitaille, Yolande.** Observations sue les phénomènes périglaciaires de l'île Akpatok [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 100, 1967.

05153 **Dorman, James.** Computing methods in seismology, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 423–426, 1967.

The discovery of the fast Fourier transform method has reduced the cost of data processing more significantly than ten years of improvements in computer technology. Other recent advances in computing methods have been based on an increasing variety of computer-oriented data acquisition and display equipment. Equipment designed to handle data directly in its existing external form is opening the way to many new applications. Specialized devices that can be used only for a single specific application should be avoided in research-oriented systems. A bibliography of pertinent works is given.—DBV

Douglas, J. A. V. *See* Folinsbee, R. E. 05413

05146 **Douze, Eduard J.** Microseisms, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 400–402, 1967.

Research on microseisms in the United States in 1963–67 is summarized, with bibliography. To facilitate the discussion, microseisms are divided somewhat arbitrarily into short- and long-period, with the spectral peak at 6.0 sec as the dividing line.—DBV

Drake, David P. *See* New England Intercoll. Geol. Conf. 04935

Drapier, Lyn. *See* Andrews, J. T. 05193

Dreimanis, A. *See* Westgate, J. A. 05341

05013 **Drummond, R. Normand.** Problèmes de géologie glaciaire de la région du lac Cambrien, Nouveau-Québec [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 96–97, 1967.

05008 **Dubé, Jean-Claude.** Découverte de dépôts de loess dans le sud due Québec [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 101, 1967.

05414 **Duke, Michael B.; Silver, Leon T.** Petrology of eucrites, howardites and mesosiderites, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1637–1665, illus., tables, 1967.

The eucrite and howardite calcium-rich achondrites and many mesosiderites are considered as a coherent meteorite assemblage. Eucrites are unbrecciated and monomict brecciated achondrites, and howardites, polymict brecciated achondrites. Many mesosiderites contain brecciated structures, but have a larger metallic fraction than achondrites. The structure and composition of rock fragments in the breccias indicate a complicated sequence of events including magmatic differentiation, brecciation, recrystallization and refragmentation, and ejection from the parent body. Polymict breccias probably formed either in very large or repeated fragmentation events, and monomict breccias by small or single events. A lunar origin for eucrites, howardites and mesosiderites is proposed, but an asteroidal origin cannot be excluded.—*from* Authors' abstract

05392 **Dunay, Robert E.** The use of pollen analysis in the interpretation of the late Pleistocene: Geol. Rev., v. 13, no. 1, p. 1–7, tables, 1967.

The first area studied is Singleterry Lake, N. C., from which 19-ft cores were taken. Three organic layers were revealed, separated by layers of sand and sandy silt. The middle layer was dated at 38,000 yr. A spruce-fir maximum, a little above the middle organic layer, is interpreted as corresponding to the Wisconsin glacial advance, changing to a warmer dry climate evidenced by an oak climax. Overlying cypress pollen indicates a more moist climate. Below the spruce-fir peak, deciduous pollen and the organic layer suggest the milder Sangamon interval. The second area was Weber Lake in the unglaciated area of Minnesota, cores of which showed sand overlain by silt and clay, with gyttja at the base; seven zones can be recognized. The horizon corresponding to the spruce-fir contains very few arboreal grains; similar plants are found in the tundra today. As the glacier retreated, a deciduous maximum was reached about 10,000 years ago.—ESL

05427 **Dundon, Robert W.; Walter, Louis S.** Ferrous ion order-disorder in meteoritic pyroxenes and the metamorphic history of chondrites: Earth and Planetary Sci. Letters, v. 2, no. 4, p. 372–376, illus., tables, 1967.

The Fe-57 Mössbauer absorption was used to investigate ferrous ion order-disorder in pyroxenes separated from 25 stony meteorites. Equilibrated chondrites have ordered Fe^{II} in their pyroxenes, with the exception of Farmington. The examined unequilibrated chondrites, with the exception of Mezö-Madaras and Clovis No. 1, have considerable ferrous ion disorder. These results are in agreement with the theory of J. A. Wood on the origin of meteorites. Bjurbole pyroxene probably retains disordered ferrous ion, which is interpreted in terms of metamorphism at higher temperatures than Mezö-Madaras and Clovis No. 1. The unusually high degree of disorder in the Farmington pyroxene is more likely the result of reheating

Durham, C. C. *See* Lynch, J. J. 05122

05268 **Durum, Walton H.; Hem, John D.** Geochemistry of water, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 741–744, 1967.

Major advances on many fronts in geochemistry of water have occurred since 1963 through accelerated interest of earth scientists in solubility studies in aqueous solutions. Public attention to problems in hydrology and water quality management has undoubtedly contributed to this surge of interest in and voluminous contributions to the science. Various aspects of research are commented on, and a bibliography of pertinent works is given.—DBV

00005 **Dutro, J. Thomas, Jr.** Paleontology: Geotimes, v. 13, no. 1, p. 17–18, 1968.

Major conferences in this field in 1967 led to valuable compromise agreements, especially on critical problems of boundaries and correlation. There were several interesting developments in paleontologic publication during the year, including special paper series to accomodate longer papers to be published by both major English language journals.—ESL

00022 **Dutton, Carl E.** Summary report on the geology and mineral resources of the Huron, Seney, Michigan Islands, Green Bay, and Gravel Island National Wildlife

Refuges of Michigan and Wisconsin: U.S. Geol. Survey Bull. 1260-I, p. I1–I14, illus., 1968.

The Huron, Michigan Islands, and parts of the Seney [Michigan], Green Bay, and Gravel Island [Wisconsin] National Wildlife Refuges are being considered for inclusion in the National Wilderness Preservation System. Surface materials of most of these areas are largely sand or gravel of Pleistocene or Recent age. Bedrock of the Huron Refuge is reported to be granite but that of the others is believed to be largely sedimentary rock of Paleozoic age. In all areas, bedrock types are those common in nearby areas; the bedrock is unlikely to be exploitable in or near the refuge areas. There are no records of mineral production and no known mineral deposits of commercial significance; the potential is poor.—*from* Author's abstract

05248 **Dyer, Kenneth Lee.** Effect of CO_2 on the chemical equilibrium of soil solution and ground water [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1601B, 1967.

05064 **Eden, W. J.** Buried soil profile under apron of an earth flow: Geol. Soc. America Bull., v. 78, no. 9, p. 1183–1184, illus., 1967.

An earth flow in sensitive clays of the Saint Lawrence Valley, near Ottawa, covered and preserved an old soil profile. Recent exposure of the flow–soil contact in a sewer trench afforded an opportunity to study the contact and soil profile in detail. The preserved soil profile includes a layer of peaty material dated about 1,140 years B.P. An abundance of organic debris, a preferred orientation of the debris pointing away from the scar, the intimate mixing of flow and organic debris, the very flat slopes involved, and slope stability studies indicate very wet conditions at the time of the earth flow and that the former wooded area probably had been struck by an onrushing wave of liquid clay from the flow.—EHP

Ediger, N. M. *See* Brisbin, W. C. 05363

04895 **Edwards, J. M.; Ottinger, N. H.; Haskell, R. E.** Nuclear log evaluation of potash deposits, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. L1–L12, illus., 1967.

Nuclear logging is not new to the oil industry. In the last few years this method of reservoir analysis has been applied to evaluating potash deposits in the United States and Canada. The purpose of this paper is to report results from deposits in the Paradox Basin in the United States and the Prairie Evaporite section in Saskatchewan, Canada. In order to properly evaluate results of interpretation procedures as developed through field use it is necessary to briefly explain the principles of operation, the type of equipment available for field use, interpretation principles as a result of laboratory and field experience, actual field results in various areas and recommended operating procedures.—Authors' abstract

05001 **Egorov, S. V.; Luege, José R.** Hidrogeología de Cuba: Havana, Cuba, Inst. Nac. Recursos Hidráulicos e Inst. Cubano Recursos Minerales, 84 p., illus., 1967.

The five chapters of this volume cover: compilation of the hydrogeologic map accompanying the report, the first made of Cuba; physical-geographical factors of ground-water origin; geologic structure and water-bearing capacity of the Jurassic to Quaternary deposits; principal dynamic laws, and chemical composition of ground water; and description of the 24 hydrogeologic regions. It is concluded that the principal ground-water resource is in hollows and cracks in the complex of Miocene limestones.—ESL

Ehmann, William D. *See* Schmitt, R. A. 05410

Ehmann, William D. *See* Tanner, James T. 05412

05072 **Eilers, L. J.** The postglacial phytogeography of the Iowan lobe: Iowa Acad. Sci. Proc. 1965, v. 72, p. 84–98, illus., 1967.

Evidence is summarized from the area of the Iowan lobe of Wisconsin glaciation which pertains to migrations of regional vegetation following Wisconsin glaciations. The most recent climatic fluctuation to influence distribution of present flora was the Hypsithermal interval. Present distributions of several species are discussed in relation to postglacial history of the flora; eleven distribution maps of representative species are included. Most distribution patterns can be attributed to factors other than continuing postglacial migration. These plant distributions are primarily a function of distribution of available habitats. Most species appear to have had sufficient time since the Hypsithermal interval to complete their migration into the Iowan lobe and to become well established. Need for additional paleobotanical and phytogeographic research in Iowa is stressed.—*from* Author's abstract

Einaudi, Marco T. *See* Marvin, Ursula B. 05400

04899 **Eller, E. R.** A review of Hinde's annelid jaws from the Silurian at Dundas, Ontario: Carnegie Mus. Annals, v. 39, art. 10, p. 143–148, 1967.

Thirteen species in eight genera of scolecodonts were described by Hinde in 1879 from what is now the Eramosa Member of the Lockport Formation and the Manitoulin Formation. These are re-evaluated inasmuch as the type species appear to have been illustrated by a delineator and the original descriptions made from the drawings and not the specimens.—HRC

04927 **Eller, E. R.** A review of Hinde's annelid jaws from the Cincinnatian of Canada: Carnegie Mus. Annals, v. 39, art. 8, p. 115–124, 1967.

Three indeterminate forms, 26 species in seven genera of scolecodonts were described by Hinde in 1879; they are from Cincinnatian rocks near Toronto, Ontario. The originals appear to have been drawn by a delineator and the type descriptions based upon the drawings rather than the specimens. The whole suite is re-evaluated. *Leodicites innesi*, a part of the original suite, is newly named and described.—HRC

04930 **Eller, E. R.** A review of Hinde's annelid jaws from the Hamilton (Devonian) at Rivière au Sable, Ontario: Carnegie Mus. Annals, v. 39, art. 11, p. 149–151, 1967.

Three genera and eight species of scolecodonts were described by Hinde in 1879. After examining the type specimens it is suggested that the illustrations were made by a delineator and that the descriptions were based on these drawings rather than on the specimens. Some of the illustrations are fairly accurate but license seems to have been taken in details such as the number of denticles and the rendering of broken edges.—HRC

05396 **Elliott, C. L.; Kellogg, William C.** Mining geophysical activity: Geophysics, v. 32, no. 6, p. 1065–1072, illus., tables, 1967.

This constitutes a part of the overall report on geophysical activity in 1966 (Tucker, preceding paper), giving statistics for mining geophysics separately.—DBV

05082 **Elwell, James H.; Lemish, John.** Lithologic control of alkali-induced expansion in carbonate rock from Decorah, Iowa: Iowa Acad. Sci. Proc. 1965, v. 72, p. 343–350, illus., table, 1967.

A study of the overall linear expansion of carbonate rock cores in an alkaline environment was extended to include the distribution of expansion along the length of the core. For the material tested, it was found that the fracture pattern, radial expansion and overall linear expansion were associated with bedding planes and stylolitic seams. The formation of voids and the constant association of iron stains both with pyrite and expansion zones places pyrite under suspicion as an indicator of a type of expansive lithology. The radial expansion distribution provides a basis for separating expansive and non-expansive lengths of core. The analyses of the chemical and physical properties of the differential lengths of core might then be used to describe the nature of changes found in differential expansion.—Authors' abstract

Elwell, James H. *See* Kemp, Paul J. 05083

Emery, K. O. *See* Martin, Bruce D. 04948

04998 **Emery, K. O.** Geological aspects of sea-floor sovereignty, Chap. 9 *in* The law of the sea—Offshore boundaries and zones (Lewis M. Alexander, editor): [Columbus, Ohio] Ohio State Univ. Press, p. 139–159, illus., table, 1967.

All reasonable geological boundaries of the sea floor—shoreline, shelf edge, base of continental slope, toe of continental rise, axes of trenches, deepest parts of abyssal plains, and the mid-ocean rift—are described according to their origin and value as seaward limits of national sovereignty for mining purposes. All contain uncertainties or deficiencies stemming from present inadequate knowledge of bathymetry, ambiguity of definition, or unreasonable relationship to areas of possible mineral resources. Perhaps the best seaward boundary for coastal nations is the 1,000 m depth contour of the main ocean basins, with some form of international jurisdiction applied to the deeper area of the ocean floor.—*from* Author's abstract

05298 **Emiliani, Cesare.** Memorial to Louis Lidz (1938–1967): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2313–2314, portrait, 1967.

04980 **Engineering Geology.** Memorial, Ray C. Treasher (1898–1967): Eng. Geology, v. 4, no. 2, p. 70–71, portrait, 1967.

04981 **Engineering Geology.** Memorial, Robert E. Evenson (1924–1966): Eng. Geology, v. 4, no. 2, p. 72, 1967.

05359 **Erdosh, George.** Density-fraction X-ray analysis—A new technique of modal analysis of rocks: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1093–1117, illus., tables, 1967.

X-ray powder diffraction is found to be useful when combined with density separation. The powder is split into three density fractions by heavy liquids and each examined by X-ray for its major constituents. Twenty-eight common igneous and metamorphic minerals are considered, and calibration curves for 10 of them are created; with one exception the precision was good. The accuracy of the technique could not be tested, however. The analytical time varies from 2 to 4 man-hours per sample depending on the rock type. This study is preliminary and the proposed technique is incomplete; it obviously shows some advantages over point counting for many rock types.—*from* Author's abstract

Erickson, R. L. *See* Canney, F. C. 05096

00002 **Erickson, Ralph L.** Economic geology: Geotimes, v. 13, no. 1, p. 11–12, 1968.

The year 1967 saw the surge in mineral exploration continuing at a high level, the most important reason being competition for deposits to replace rapidly dwindling reserves. Major developments are: a strong movement into nonfuels exploration by oil companies, increased foreign exploration, increased emphasis on offshore exploration, research in ore-finding techniques, research under the heavy metals programs of the U.S. Geological Survey and Bureau of Mines, application of isotope geology and of remote sensors to exploration, increased use of aerial color photography, continuation of empirical data research in many companies, discovery of the Carlin-type deposits in Nevada, and of dawsonite and nahcolite in oil shales of Colorado, and a proposed experiment in nuclear fracturing and solution mining of copper.—ESL

05158 **Ernst, W. G.** Experimental metamorphic petrology, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 661–666, 1967.

In 1963–67 there was a considerable increase in the number of papers dealing with experimental metamorphic petrology. It has become increasingly evident that many metamorphic reactions take place in the presence of a multicomponent fluid phase. Investigations of the strengths of experimentally stressed geologic materials and the

resultant textures continue. The overwhelming majority of experimental papers dealing with metamorphic petrology has been concerned with pressure-temperature stability relationships of individual minerals or mineral groups. A bibliography of pertinent works is given.—DBV

05225 **Essene, Eric John.** Petrogenesis of Franciscan metamorphic rocks [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1575B–1576B, 1967.

05157 **Eugster, Hans P.** Experimental igneous petrology, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 654–661, 1967.

The most obvious change in the field since 1963 is that it is now easy to perform experiments in petrology; but it has become harder to design and perform a set of experiments meaningful in terms of natural environments. Most striking progress is the increase in understanding of the crystallization of basalts. In many areas of igneous petrology we have reached the point where we know more about the phase relations of a particular rock than about its natural environment. Much quantitative and detailed work on natural rocks is needed to close the gap. The electron probe should have an enormous impact in this area. An extensive bibliography (more than 5 pages) is given.—DBV

04983 **Evans, Hilton B.; Cotterell, C. H.** Synthesis of modulus logs from acoustic parameters—Some preliminary results, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. AA1–AA33, illus., 1967.

Compressional wave velocity, recorded by acoustic logging devices, can be converted to bulk density values at corresponding depths, and vice versa. The conversion technique is based on empirical expressions relating either the compressional wave velocity, or density, to elastic moduli measured in a variety of rock types. Hence, the plane wave modulus factor permits the computation of either compressional wave velocity or density when the other variable is known. Collectively, these curves are "modulus" or "elastic parameter" logs. A computer program carries out the conversion. Synthetic density logs can be computed from common logs for use with gravity surveying. Synthetic seismograms can be computed from the synthetic density logs, calculated from reflection coefficient functions. Other uses are also described.—*from* Authors' abstract

05065 **Fagerstrom, J. A.** Stratigraphic and paleogeographic significance of the Holland Quarry Shale (Lower Devonian), northwestern Ohio: Geol. Soc. America Bull., v. 78, no. 9, p. 1185–1190, illus., table, 1967.

The Holland Quarry is a black shale formerly exposed at a single outcrop located near Toledo, Ohio. Local stratigraphic relations and the carbonaceous nature of the shale suggest that it was deposited in a small, stagnant embayment occupying a previously eroded channel. Regional stratigraphic relations indicate that at the time of deposition of the shale, the Michigan Basin and adjacent areas of the craton were emergent; the nearest contemporaneous marine rocks are located in southeastern Ohio. The Holland Quarry fossil assemblage is a mixture of marine, brackish, and terrestrial elements suggestive of deposition in an estuarine environment. The dominant endemic forms consist of nektonic and vagrant benthonic fishes and eurypterids. Neither the length nor the location of the mouth of the estuary can be determined from presently available information.—*from* Author's abstract

05331 **Fairbairn, H. W.; Moorbath, S.; Ramo, A. O.; Pinson, W. H., Jr.; Hurley, P. M.** Rb-Sr age of granitic rocks of southeastern Massachusetts and the age of the Lower Cambrian at Hoppin Hill: Earth and Planetary Sci. Letters, v. 2, no. 4, p. 321–328, illus., tables, 1967.

Rb-Sr whole-rock analysis of granitic rocks in southeastern Massachusetts gives isochron ages and initial Sr-87/Sr-86 ratios: Dedham, 591±28 m.y., 0.7054±0.0010; Northbridge, 569±4 m.y., 0.7058±0.0005; Hoppin Hill, 514±17 m.y., 0.7128±0.0067. The Hoppin Hill exposure lies unconformably beneath Lower Cambrian quartzite and slate. All three igneous bodies are believed to be

comagmatic and late Proterozoic; 570±20 m.y. is the best present age estimate. Twenty m.y. may be adequate for time between emplacement of underlying magma and deposition of Lower Cambrian sediments; this would give 550 m.y. for the base of Cambrian and allow 50 m.y. for entire Cambrian. For the New England area, we propose to designate the late Proterozoic igneous event, provisionally dated at 570±20 m.y., as the Neponset.—*from* Authors' abstract

04918 **Farquhar, O. C.** Engineering geology in the Westfield and Manhan Rivers, Trip F *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ., Dept. Geology] p. 89–104, illus., 1967.

Features of the geologic environment are stressed and engineering aspects of construction materials and methods are discussed for dams, reservoirs, and sites near Huntington in the Berkshire Mountains of western Massachusetts. The projects visited include: Manhan water-supply dam and reservoir on the Manhan River; Knightville flood-control dam on the Westfield River; Springfield municipal water works on the Little River (tributary to the Westfield), consisting of several dams, reservoirs, and other units. The Westfield River and the smaller Manhan, both tributary to the Connecticut River, drain a rugged upland region underlain by schists and gneisses; the entrenched stream valleys are filled with varying thicknesses of glacial overburden. Geologic sections (valley profiles) are given for the dam sites, and test data for Knightville Dam.—VMJ

05226 **Farrar, Edward.** The extraction and ultra-high vacuum mass spectrometry of argon from rocks [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1576B, 1967.

05381 **Filloux, J. H.** An ocean bottom, D component magnetometer: Geophysics, v. 32, no. 6, p. 978–987, illus., 1967.

The distribution of electrical conductivity in the oceanic crust and upper mantle may be estimated from measurements of relations between magnetic fluctuations and induced electrical field at the ocean bottom. Techniques for measuring the electrical field are available; a simple instrument for recording horizontal magnetic fluctuations to the magnetic east (D) on the sea floor at any depth is described here. This magnetometer uses a magnet pair which orients itself along the main horizontal field H; after the instrument has reached bottom, magnets are coupled to the mirror of a gamma-sensitive optical lever. Resolution is 1 γ or less, dynamic range at least 2,500 γ. The instrument can record for about 40 days at a rate of 30 readings per hour, on self-contained dry cells. It is recovered by means of a mooring line connected to a surface float. Fluctuations observed on the North Pacific Ocean floor are given.—DBV

05387 **Finkelman, Robert B.** The sharks' teeth of the Calvert cliffs: Geol. Rev., v. 13, no. 1, p. 8–13, illus., 1967.

The Calvert Cliffs, along the western shore of Chesapeake Bay in Maryland, is an excellent location for collecting fossil vertebrate and invertebrate remains. The cliffs consist of three Miocene formations: the Calvert, best exposed from Chesapeake Beach south to the mouth of Parker Creek; the Choptank, exposed between the mouth of Parker Creek and Cove Point; and the St. Mary's, best exposed around Little Cove Point. All are composed of unconsolidated sands, clays, and biogenic deposits. About 550 teeth were collected from Chesapeake Beach, Plum Point, and Governor Run, representing all the genera and most of the species identified from the cliffs. No attempt is made to correlate them. The teeth are described and 18 are illustrated.—ESL

05383 **Finley, Robert.** Adirondack anorthosites: Geol. Rev., v. 13, no. 1, p. 19–22, 1967.

Anorthosites are monomineralic rocks consisting mainly of andesine or labradorite. One occurrence, limited to the Precambrian, takes the form of a vast intrusion covering thousands of square kilometers. Field evidence does not indicate high temperature of emplacement around this body, although the melting point of

andesine–labradorite is 1,400°C. One hypothesis is that in the Adirondacks, gabbro, anorthosite, and pyroxene–quartz syenite formed from a diorite magma during intrusion. An alternative hypothesis is that the anorthosites and gabbros are derived from a gabbroic anorthosite magma, liquid at 1,350°C because of high pressure. Many workers believe that the anorthosites were intruded as a mush of crystals, precipitated from a gabbroic or dioritic magma.—ESL

05415 **Fireman, E. L.** Radioactivities in meteorites and cosmic-ray variations, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1691–1700, illus., tables, 1967.

The Na–22:Al–26 ratio in six recently fallen meteorites, including Příbram, and the Ar–37:Ar–39 ratio in three recently fallen meteorites were measured. The Na–22:Al–26 and Ar–37:Ar–39 ratios are indicators of variations in the cosmic-ray bombardment of meteorites. The Na–22:Al–26 ratios, which are produced by cosmic rays integrated over the meteoroid orbit, show that the 11-yr cosmic-ray variation is smaller at the average solar distance of most meteoroids than at 1 a.u. The Ar–37:Ar–39 ratios, which compare cosmic rays in the neighborhood of 1 a.u. with those at the average solar distance of the meteoroid, have a high-energy cosmic-ray heliocentric radial gradient of 20±8 percent/a.u. at solar maximum and at solar minimum.—Author's abstract

Fisher, D. E. *See* Berkey, E. 05406

05413 **Folinsbee, R. E.; Douglas, J. A. V.; Maxwell, J. A.** Revelstoke, a new Type I carbonaceous chondrite, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1625–1635, illus., tables, 1967.

The Revelstoke meteorite fell on March 31, 1965 in a desolate glaciated mountain-area in southeast British Columbia. Visual observations indicate that the bolide traveled along an azimuth of 093 at an inclination to the horizontal of 15°. About 1 g of disaggregated material was recovered from the snow on a small frozen lake lying along the trace of the trajectory. This material was initially identified as a Type I carbonaceous chondrite by direct comparison by X-ray fluorescence spectroscopy with the Orgueil meteorite. Textural and mineralogical relationships in Revelstoke closely resemble those of Alais and Orgueil. The chemical composition of Revelstoke is similar to that of Orgueil.—Authors' abstract

Fontanel, A. *See* Bauer, A. 04949

Foose, Richard M. *See* Brophy, Gerald P. 04898

05099 **Fortescue, J. A. C.** Geochemical prospecting, case histories and exploration architecture [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 270, 1967.

05125 **Fortescue, J. A. C.; Hornbrook, E. H. W.** A brief survey of progress made in biogeochemical prospecting research at the Geological Survey of Canada 1962–65, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 111–133, illus., 1967.

The general objectives of the biogeochemical prospecting research program of the Geological Survey of Canada are described, with an outline of progress in the period 1962–65. The program is aimed at acquiring data on the scope and limitations of biogeochemical and geobotanical prospecting methods under Canadian conditions. The plant prospecting research program is designed to carry out systematic studies of plant ecology and the rock, soil, and plant geochemistry of landscapes in the vicinity of known, but undisturbed, mineral deposits. Special efforts will be made to carry out soil and plant studies of a given area at "an instant in time" with comprehensive sampling and chemical analyses. Descriptions of methods and field investigations are included.—MST

Fox, Paul J. *See* Schneider, Eric D. 05425

00019 **Frazier, Kenneth.** Marine fossils in Southern California: Earth Sci., v. 21, no. 1, p. 13–16, illus., 1968.

Collecting localities for Pleistocene invertebrates in the marine terrace deposits at Newport Beach, Del Mar, and San Diego are described and specimens illustrated. Shark and porpoise teeth from the Pliocene San Diego Formation are shown also.—ESL

05342 **Frebold, Hans.** Position of the Lower Jurassic genus *Fanninoceras* McLearn and the age of the Maude Formation on Queen Charlotte Islands: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1145–1149, illus., 1967.

The Lower Jurassic ammonite genus *Fanninoceras* McLearn hitherto considered to belong to the family Hildoceratidae Hyatt is now assigned to the family Oxynoticeratidae Hyatt. Its age is probably early Pliensbachian. The Maude Formation of the Queen Charlotte Islands hitherto considered to be entirely Toarcian in age is shown to include upper Sinemurian and lower Pliensbachian. In the underlying Kunga Formation ?*Arniotites* indicate lower Sinemurian.—Author's abstract

05416 **Fredriksson, Kurt; Kraut, Francois.** Impact glass in the Cachari eucrite, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1701–1704, illus., table, 1967.

The black, glassy parts in the Cachari eucrite have been studied by optical microscopy, electron microprobe, and X-ray diffraction techniques. It is suggested that the glass formed by localized shock pressure caused by preatmospheric, hypervelocity impact.—Authors' abstract

05100 **Friedrich, G. H.; Hawkes, H. E.** Mercury dispersion haloes as prospecting indicators at the base-metal deposits, West Shasta district, California [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 270, 1967.

Fristrup, Borge. *See* Bendix-Almgreen, Svend E. 05213

04972 **Frye, John C.** Geological information for managing the environment: Illinois Geol. Survey Environmental Geology Note 18, 12 p., 1967.

This paper was prepared for the symposium, "Limitations of the Earth—A compelling focus for geology," held in November 1967 at Austin, Tex. The data have been considered in four groups: physical data on the terrain needed for physical planning; problems of waste disposal; data needed for evaluation, utilization, and management of water; and the need for assessing, evaluating, and mapping the rock and mineral resources in and adjacent to urbanizing regions. Environmental geology consists of these areas combined. It is urged that serious thought be given to converting the great stock of scientific data available about the Earth's crust to the physical environment of urbanizing areas. This involves learning about the problems of the planner and administrator.—*from* Author's summary

05397 **Fuchs, Louis H.; Olsen, E.; Henderson, E.** On the occurrence of brianite and panethite, two new phosphate minerals from the Dayton meteorite, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1711–1719, illus., tables, 1967.

Two new phosphate minerals, brianite $Na_2CaMg(PO_4)_2$, and panethite $(Na,Ca)_2(Mg,Fe)_2(PO_4)_2$, have been found in phosphate-silicate nodules in the Dayton very fine octahedrite. Chemical, optical and physical data are presented for these minerals, and some of the implications of their presence are discussed.—Authors' abstract

05059 **Fujii, Takashi.** Graphical extrapolation for critical composition of binary system: Am. Jour. Sci., v. 265, no. 8, p. 685–691, illus., tables, 1967.

Two simple graphic methods are given to reduce the difficulties in critical composition extrapolation of a binary system. Each is based on the limiting slope of the curve constructed from the composition of the two coexisting phases. It is shown that the limiting slope under consideration is always the same regardless of the symmetry of the solvus; this property is derived mathematically.—VSN

05060 **Fujii, Takashi.** Graphical determination of critical temperature of binary system: Am. Jour. Sci., v. 265, no. 8, p. 692–695, illus., 1967.

Near the critical point, the solvus of a binary system becomes a parabola. The critical temperature, that is, the vertex of the parabola can be determined graphically by its geometrical property.—Author's abstract

Fuller, M. D. *See* Carmichael, R. S. 04958

05379 **Funk, H.; Podosek, F.; Rowe, M. W.** Fissiogenic xenon in the Renazzo and Murray meteorites, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1721–1732, illus., table, 1967.

We reinterpret the xenon data from a stepwise heating of the Murray and Renazzo carbonaceous chondrites by Reynolds and co-workers and confirm the exceptionally large amounts of fisson-produced xenon postulated by Reynolds' group. Our interpretation supports the existence of three components of xenon in Murray and Renazzo, probably best explained as (1) a primitive trapped component, (2) a fission component, and (3) an atmospheric-like component. The excessive amounts of fissiogenic xenon cannot be accounted for by atmospheric contamination, cosmic-ray xenon or diffusion effects.—Authors' abstract

05271 **Furon, Raymond.** The problem of water—A world study [translated from French by Paul Barnes]: New York, American Elsevier Publishing Co., 208 p., illus., 1967; originally published 1963.

In this general study of water in a world of exploding population, the topics discussed include its biological importance; composition and products of sea water; fresh water occurrences on the surface and underground sources; historical and modern requirements for agriculture in various regions of the world; damage by floods, soil erosion and dissolution; present needs in industry; urban drinking-water supplies; pollution; exploration history and methods, and ground-water exploitation; development in arid zones; dew as a source of drinking water; question of synthesis; and desalinization techniques. A substantial bibliography is presented.—GDC

Fyfe, W. S. *See* Leonardos, O. H., Jr. 05035

05042 **Fyfe, W. S.; Zardini, R.** Metaconglomerate in the Franciscan Formation near Pacheco Pass, California: Am. Jour. Sci., v. 265, no. 9, p. 819–830, illus., 1967.

Matrix and pebbles from a conglomerate contain the same mineral assemblages, dominated by quartz-jadeite and lawsonite. Relict mineralogy and(or) textures of pebbles indicate a wide variety of original rock types from graywacke and tuff to porphyry and light-colored granitic rock. Some pebbles are concentrically zoned with metamorphic minerals, and metamorphic minerals may cross apparently sharp pebble boundaries. These features plus high soda and calcium and low potash contents of the pebbles and matrix indicate that pebbles, matrix, and enclosing metagraywackes were metamorphosed and extensively metasomatized at the same time.—RWT

05069 **Fyson, W. K.** Gravity sliding and cross folding in Carboniferous rocks, Nova Scotia: Am. Jour. Sci., v. 265, no. 1, p. 1–11, illus., 1967.

Folded Carboniferous sedimentary rocks in northern Nova Scotia lie within the Fundy basin, a broad area that during the Carboniferous was separated into smaller troughs by positive basement blocks. The main folds in the Carboniferous follow the Acadian trends and are dominantly overturned toward the areas where the sediments are thickest. This relationship suggests that subsidence during Carboniferous sedimentation, perhaps accompanied by normal faulting along earlier

structures, was succeeded by gravity sliding toward the center of subsidence. Cross folds, which appear to have formed directly after the main folds in the Carboniferous, trend consistently north to north-northeast and are closely parallel to late Acadian cross folds.—*from* Author's abstract

05274 **Gaber, Norman H.** Your future in oceanography: New York, Richards Rosen Press, 143 p., illus., tables, 1967.

Following an introduction to oceanography, in which the problems and hazards of the recent retrieval of a lost H-bomb from the sea depths southeast of Spain illustrate its challenges, there is a review of the related sciences and marine engineering, the organizations involved in oceanography, its future and business, careers, and academic preparation. Appendices list undersea research vehicles in operation, international oceanographic organizations, U.S. professional and trade associations, funding, selected private firms, products and services used, personnel, and colleges and universities offering degrees in oceanography and marine science.—GDC

05365 **Gafford, Edward L., Jr.** Scolecodont carriers from the Lower Permian of Kansas: Oklahoma Geology Notes, v. 27, no. 12, p. 230–232, illus., 1967.

Twenty specimens of scolecodont carriers (attachments to pharyngeal jaws of annelid worms), 30 to 55 microns in length, were recovered from insoluble residue of the Fort Riley Limestone in Augusta quarry, Butler County, Kans. Many were not attached to the jaws. *Arabellites* and *Nereidavus* jaws and several unnamed, unattached carrier pairs are illustrated. Stude (1961), working in the same area, extended the upper range of Paleozoic scolecodonts from Lower Mississippian to Lower Permian, but did not report the occurrence of carriers.—VMJ

05170 **Gagnon, P. M.; MacKenzie, G. D.** Formation top correlation furthers oil technology: Oilweek, v. 18, no. 45, p. 14–15, illus., 1967.

A project, recently completed, set up regional cross-sections from the Rocky Mountains to the Precambrian Shield for the four western Canadian provinces, to obtain uniform correlation of formation tops. Wells not on these cross sections were correlated to the closest one and data entered onto a magnetic tape library for computer applications. There are 567 cross sections for the sedimentary basin, with a total of 3,899 wells; the remaining wells correlated gave a total of about 43,200. The data are being used to construct isopach, structure, and residual maps.—ESL

Gammon, Nathan, Jr. *See* Yuan, T. L. 05323

Ganapathy, R. *See* Clark, R. S. 05421

05366 **Ganser, Robert W.** Recent delta growth in the Butcher Pen, Lake Texoma, Oklahoma: Oklahoma Geology Notes, v. 27, no. 12, p. 232–233, illus., 1967.

A large delta has been built recently by the Washita River where it empties into northern Lake Texoma. The area is underlain by the Cretaceous Caddo and Kiamichi Formations. Aerial photographs taken of the same area in 1956 and in 1963, when the lake level was higher, show changes in the river channel and an increase of 1.8 square miles in the exposed surface area of the delta.—VMJ

Garrett, R. G. *See* Nichol, Ian. 05089

Garside, Larry J. *See* Johnson, Gary D. 05081

Gass, Ian G. *See* McBirney, Alexander R. 05333

05052 **Gates, Robert M.** Amphibolites—Syntectonic intrusives?: Am. Jour. Sci., v. 265, no. 2, p. 118–131, 1967.

Many of the amphibolites in the metamorphic terrane of the highlands of northwestern Connecticut are considered to be basic intrusives that accompanied

orogeny and metamorphism. Most were emplaced after the metasediments had acquired their pronounced micaceous foliation, but before tectonism ceased. By far the greatest percentage of the amphibolites are conformable bodies and not distinguishable from para-amphibolites on this basis. Their textures reflect the time of emplacement and their structural position. The amphibolites may have crystallized as primary amphibolites under pressures sufficient to retain the water content and to have hornblende as a primary phase, or they may have recrystallized during the amphibolite facies metamorphism which affected the entire region.—*from* Author's abstract

04994 **Gentile, F.** Étude stratigraphique et structurelle de la partie sud du Dome Lemieux, Cté Gaspé Nord [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 92, 1967.

05272 **Geological Society of America.** (Bibliographic Staff). Annotated bibliography of economic geology for July–December 1965, v. 38, no. 2: Urbana, Ill., Economic Geology Publishing Co., p. 175–396, 1967.

05307 **George, R. W.; Main, A. R.** The evolution of spiny lobsters (Palinuridae)—A study of evolution in the marine environment: Evolution, v. 21, no. 4, p. 803–820, illus., tables, 1967.

The family Palinuridae (Crustacea, Malacostraca) evolved from the Pemphicidae in the early Mesozoic. A phylogeny is proposed based on external morphology. The two groups, Silentes and Stridentes, show a parallel trend in several morphological features, coincident with a habitat trend from deep to shallow waters. Spiny lobsters occur in all major oceans of the world; spatial distributions of genera rarely overlap, each genus having a separate set of depth and latitude parameters. Shallow waters are the specialized habitats, and fossils indicate past radiations into shallow water; however, it is suggested that the main ancestral line is represented by deeper-water inhabitants. Speciation within *Panulirus*, the most recently evolved genus, occurred during the Pleistocene and the four species groups may reflect four major glaciations, each of which produced conditions for optimum isolation and subsequent speciation.—VMJ

04967 **Gerhard, Lee C.** Paleozoic geologic development of Canon City embayment, Colorado: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2260–2280, illus., 1967.

The Canon City embayment of Colorado has had a varied structural and sedimentologic history, including a post-Ordovician and pre-Pennsylvanian vertical structural reversal. Measured sections and isopachous maps demonstrate that early Paleozoic and Ancestral Rocky Mountain structural features occupy the same areas and are congruent with features resulting from Laramide deformation. The Priest Canyon Member of the upper Fremont Limestone is rejected, and the Williams Canyon Limestone is shown to have a much more restricted outcrop than previously thought. An early Paleozoic tectonic element of the Sierra Grande arch, the Canon City prong, affected early Paleozoic sedimentation of the Canon City area before pre-ancestral Rocky Mountain movements.—Author's abstract

05054 **Gilluly, James.** Chronology of tectonic movements in the western United States, *in* Symposium on the chronology of tectonic movements in the United States: Am. Jour. Sci., v. 265, no. 5, p. 306–331, illus.,1967.

Tectonic and plutonic history of the western United States is summarized. Age and magnitude of tectonism are shown graphically by state for Washington, Oregon, California, Nevada, Idaho, Utah, Arizona, Montana, Wyoming, Colorado, and New Mexico.

05219 **Girard, P.** Geology of Mount Richardson area, Gaspé-North county [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 563, 11 p., geol. map, 1967.

The map-area is a northern segment of the Appalachians; rocks are all lower Paleozoic. The Shickshock Group, mainly metavolcanic, outcrops in the south and

is placed in the Cambrian–Ordovician. The remainder are Lower Ordovician, Deepkill or older. The McGerrigle granitic intrusion crops out along the east margin, and is flanked by a zone of alteration. Basic and acid dikes invade the map-area, particularly in the northwest. Deformation is marked by two schistosities, and some folding and faulting. Some mineralization occurs in the Castor Lakes and Porc-Epic Brook areas. Five major brooks in the Castor Lakes area were sampled and showed geochemical anomalies.—ESL

05101 **Gleeson, C. F.; Tupper, W. M.** Coding system and field card for geochemical surveys of streams [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 271, 1967.

05118 **Gleeson, C. F.** The distribution and behaviour of metals in stream sediments and waters of the Keno Hill area, Yukon Territory, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 134-144, illus., 1967.

The planning, execution, and discussion of preliminary results of the Geological Survey of Canada's first helicopter-supported regional geochemical-heavy mineral survey are the basis of this paper. Stream and spring sediments and waters were systematically sampled and tested at the site for cold extractable heavy metals, over a 1,900 square mile area. Heavy mineral samples were panned from stream gravels, and rock samples were collected for trace-element studies. Geochemical maps showing the heavy metal content of stream, spring waters, and sediments are being published. Computer analysis of the data is planned. Using the results of only cold extraction field tests, strong trends and regional relationships to rock types can be shown and favorable areas for prospecting indicated.—MST

05120 **Gleeson, C. F.; Coope, J. A.** Some observations on the distribution of metals in swamps in eastern Canada, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 145-166, illus., table, 1967.

This paper describes results obtained from geochemical investigations in poorly drained areas near Kenora, Ontario; Amos, Quebec; and Daniel's Harbour, Newfoundland. The peat and clay samples were analysed for copper, zinc, lead and nickel. In all profiles the zinc, copper, and nickel values tended to increase gradually from surface to the bottom of the peat. The lead content of the peats was very small and the limited sensitivity of the analytical method prevented its use as an indicator. The physical characteristics of the swamps and vertical distribution of trace elements in the swamp profiles in the three areas are essentially similar. The metals in the peats were probably derived from the lake and swamp waters with which they are saturated. The pH in the peats of the three bogs ranges from 5.5 to 7.5.—MST

05201 **Gluskoter, H. J.** Chlorine in coals of the Illinois basin: Soc. Mining Engineers Trans., v. 238, no. 4, p. 373-379, illus., 1967.

The chlorine content of coals in the Illinois basin ranges from 0 to more than 0.6 percent; that of the Herrin (No. 6) Coal has been mapped on a regional scale and, in general, increases with the depth of the coal. The depth-chlorine correlation exists because the coal is in apparent equilibrium with composition of the associated ground water, and salinity of the ground water generally increases with depth. At least part of the chlorine can be easily removed from the coal in the laboratory. In a natural weathering experiment, chlorine values decreased markedly during an 8-week period. Results to date indicate that none of the coals studied has a sufficiently high chlorine content to make it unusable in high-temperature steam boilers, although special steps may be necessary in the preparation or utilization of some of the highest chlorine coals.—*from* Author's abstract

05116 **Gold, D. P.; Vallée, M.; Charette, J.-P.** Economic geology and geophysics of the Oka alkaline complex, Quebec: Canadian Mining and Metall. Bull., v. 60, no. 666, p. 1131-1144, illus., tables, 1967.

The Oka carbonatite and alkaline complex is a Lower Cretaceous intrusive body of the Monteregian petrographic province. Carbonate rocks of various types, and

associated alkaline rocks of the ijolite and okaite suites, are distributed in a double ring-dike structure 4 1/2 miles long by 1 1/2 miles across. Alnoite and alnoite breccia pipes intrude all rocks of the complex and indicate, from inclusions, that a cover of Palaeozoic rocks existed at the time of emplacement. The results of radiometric, magnetic, and gravity surveys of the complex are compiled and discussed both with respect to the regional pattern and, locally, the bedrock geology. The complex is characterized by high-intensity anomalies.—*from* Authors' abstract

Goldstein, Joseph I. *See* Buseck, Peter R. 05423

05429 **Goldstein, Joseph I.; Short, James M.** The iron meteorites, their thermal history and parent bodies, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1733–1770, illus., tables, 1967.

"Cooling rates are determined for the formation of the Widmanstätten pattern in 193 iron meteorites in order to obtain information on the number and possible types of parent meteorite bodies. About two thirds of the meteorites cooled between 1 and $10°C/10^6$ yr although the total variation in cooling rates is 0.4–$500°C/10^6$ yr. These variations indicate that the iron meteorites formed in more than one parent body, the Widmanstätten pattern formed at low pressures, and the maximum sized parent body was about 300 km in radius if the irons formed in its core." Correlations of band width, and cooling rate vs. Ni as well as structural and cosmic-ray exposure age correlations, provide strong evidence that meteorites in the Ga-Ge groups are genetically related. It is concluded that most iron meteorites come from only a few parent bodies.—KAS

05399 **Goles, Gordon G.; Greenland, L. Paul; Jérome, Dominique Y.** Abundances of chlorine, bromine and iodine in meteorites, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1771–1787, illus., tables, 1967.

Abundances of Cl, Br and, in many cases, I, in 18 chondritic meteorites, 2 octahedrites, and a terrestrial basalt have been determined by neutron activation techniques. In general, data are in agreement with those reported by previous authors, although some discrepancies are noted. Observations by Wyttenbach, von Guten and Scherle on a positive correlation of Cl:Br with Cl content in ordinary chondrites and by Reed and Allen on coherence of Cl, Br and I in carbonaceous and enstatite chondrites are confirmed. Cl:Br ratios (g/g) range from 46 to 6,700. Primordial halogen abundance ratios are estimated to be: Cl:Br about equal to 390, Br:I about equal to 13. The Murray carbonaceous chondrite is shown to be exceptional in its halogen abundances. These and other abundance anomalies suggest a complex history of halogen fractionations in meteorites.—*from* Authors' abstract

Gomez-N., P. *See* Pirson, S. J. 04888

05183 **Gordon, Robert B.** Thermally activated processes in the Earth—Creep and seismic attenuation, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 33–43, illus., 1967.

Non-elastic behavior of crystalline material results from the thermally activated motion of crystal imperfections. The mobility of a crystal defect at first increases rapidly with depth due to the steep thermal gradient, then decreases due to the effect of pressure. Thermally activated movement of imperfections controls diffusion, phase transformation kinetics, high-temperature creep, recrystallization, and the damping of elastic waves in solid mantle material. Diffusion creep, in which the motion of dislocations is not required, produces viscous flow at geologically significant rates in polycrystalline solid. Mantle viscosity due to diffusion creep passes through a minimum and is strongly depth-dependent. The damping of elastic waves is also depth-dependent but viscosity cannot be deduced from the observed internal friction.—DBV

04959 **Gough, D. I.; Reitzel, J. S.** A portable three-component magnetic variometer: Jour. Geomagnetism and Geoelectricity, v. 19, no. 3, p. 203–215, illus., 1967.

A three-component recording magnetic variometer, designed and constructed for field use, can be built at low enough cost so that simultaneous recording over an array of twenty or more instruments is possible on a moderate research budget. The design is classical, resolution is better than one gamma, variations of period greater than one minute are well recorded, and it records unattended for three weeks on power from batteries. The instrument is constructed in a long narrow tube of aluminum, stands vertically in a hole drilled in soil, and first-order thermal compensation is provided.—*from* Authors' abstract

05439 **Grant, Willard Huntington.** The geology of the Barnesville area and the Towaliga fault—Georgia Geol. Soc., Field Trip, Dec. 15, 1967, Guidebook: Atlanta, Ga., Georgia Geol. Soc., 16 p., illus., geol. map, 1967.

A general survey of the geomorphology, structural geology, and stratigraphy is given for this area in Lamar County. The rocks are entirely metamorphic and no age is assigned to them. The field trip covers more than 35 miles and makes 10 stops, each examining a rock type and structural details. The Towaliga fault is identified by stratigraphic displacement as well as by mylonite zones.—HRC

Grantz, Arthur. *See* Cobb, Edward H. 00024

Grau, G. *See* Bauer, A. 04949

Graves, Roy W. *See* Helander, Donald P. 04891

04939 **Gray, Jane; Kittleman, L. R.** Geochronometry of the Columbia River basalt and associated floras of eastern Washington and western Idaho: Am. Jour. Sci., v. 265, no. 4, p. 257–291, illus., table, 1967.

Potassium-argon dates, of the Yakima and Picture Gorge Basalts, provide information on the age and stratigraphic relations of fossil floras from sedimentary rocks, referred to the Latah Formation, that are intercalated with the Columbia River basalt near its margins in Washington and Idaho. Individual plant assemblages, assigned by paleobotanists to the Latah flora, are generaly encompassed between the basalts for which ages of 21.3 m.y. to 12.1 m.y. were obtained. Dates now available indicate that the duration of extrusion of the Columbia River Group was about 9 m.y.; that basalts of Picture Gorge type locally were extruded 21.3 m.y. to possibly 15.4 m.y. ago; and that basalts of Yakima type locally were extruded from 20.6 m.y. to 12.1 m.y. ago.—*from* Authors' abstract

05063 **Greeley, Ronald.** Natural orientation of lunulitiform bryozoans: Geol. Soc. America Bull., v. 78, no. 9, p. 1179–1182, illus., 1967.

Hypotheses on the life position of lunulitiform bryozoans have heretofore been based largely on fossils or on specimens dredged from the sea bottom, rather than on observations of live specimens in their natural habitat. Laboratory observations of living specimens of *Discoporella umbellata* (Defrance) and *Cupuladria biporosa* Canu and Bassler and associated fauna revealed that lunulitiform bryozoans survive in both apex-up and apex-down positions. Similar observations by Cook of D. *umbellata* and C. *doma* (d'Orbigny) indicated a preference by these species for an apex-up position. During the summer of 1966, specimens of D. *umbellata* and C. *biporosa* were observed living in place in waters near Ship Island, east of the Mississippi River Delta. All specimens were in an apex-up position, with the zoarial edge partly buried by sand.—Author's abstract

05299 **Green, Cecil H.** Memorial to Raymond Albert Stehr (1903–1967): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2314–2316, portrait, 1967.

00030 **Greene, Robert C.** Geologic map of the Moberly quadrangle, Madison and Estill Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-664, scale 1:24,000, section, text, 1968.

The limited resources of the Moberly quadrangle include dolomite for fill and crushed stone, and large quantities of sand of the Irvine Formation suitable after washing

for building purposes. There has been little known exploration for oil and gas.—MCM

Greenland, L. Paul. *See* Goles, Gordon G. 05399

04963 **Gretener, P. E.** Significance of the rare event in geology: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2197–2206, illus., tables, 1967.

The *rare event* is defined as an event with the low probability of a particular interplay of various factors. For example, if we have eight dice and wish to throw eight sixes, our chances of doing so in the first throw are extremely small, about 1 in 1.5 million. However, for 5×10^6 trials it will be more than 95 percent. Thus the improbable becomes probable and eventually approaches certainty. This trivial principle has applications in geology where time spans are long, and consequently the number of trials is large. Preliminary applications of this principle to geology include the dispersal of faunas and floras, disruptions in evolution, meteor impacts, the origin of life, and various others.—*from* Author's abstract

05159 **Gribbon, P. W. F.** Dielectric relaxation in temperate glaciers [with French and German abs.]: Jour. Glaciology, v. 6, no. 48, p. 897–909, illus., 1967.

The dielectric relaxation of névé and glacial ice has been studied on two temperate glaciers in Greenland and France. For wet O°C surface snow in Greenland, frequency was about equal to 4kHz and decreased with increase in density and form factor at great depths, while for the low-density, cold surface névé in France frequency was about equal to 2 kHz, and increased with increase in temperature at greater depths. All Cole–Cole diagrams showed both impurity-ion losses at low frequencies below 6 kHz, and a spreading factor of distribution in relaxation times caused by changes in physical properties of the glacier with depth. Although the method could not measure temperatures absolutely, relative temperature differences and the position of the O°C isotherm were detected when a temperature gradient existed in a glacier.—*from* Author's abstract

Gries, John Paul. *See* Niven, David W. 05207

05209 **Gries, John Paul; Niven, David W.** Investigations of water losses to sinkholes in the Pahasapa Limestone, and their relation to resurgent springs, Black Hills, South Dakota [abs.]: South Dakota Acad. Sci. Proc. 1967, v. 46, p. 245, 1967.

05259 **Griggs, David.** Hydrolytic weakening of quartz and other silicates, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 19–31, illus., 1967.

One of the processes by which rocks at high temperature and pressure become weak when exposed to an aqueous environment is hydrolytic weakening of the component crystals, when water permeates silicates. All the available evidence suggests that hydrolytic weakening is general in silicates containing small amounts of water. This phenomenon, which produces a tenfold reduction in strength of silicates in the ductile regime, should be important in the mantle, leading to a rate-dependent strength. The mantle may be very weak indeed at the low strain rates required by tectonic processes.—DBV

05252 **Griswold, George Bullard.** Some aspects of rock mechanics as applied to project Mohole [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1547B–1548B, 1967.

00006 **Gross, M. Grant; Kelling, Gilbert; Pierce, J. W.; Stanley, Daniel J.** Sedimentology: Geotimes, v. 13, no. 1, p. 18–19, tables, 1968.

In the last few years, the number of papers in this field has grown rapidly, congresses have attracted more participants, and the number of researchers has increased; the trend continued in 1967. Tables show the number of scientists working in sedimentology and related fields in North American universities in 1964 and 1966,

and aspects of sedimentology covered in papers published in 52 journals in 1967.—ESL

Grundeen, Gordon M. *See* Walton, William C. 05384

04925 **Guilday, John E.; Handley, Charles O., Jr.** A new *Peromyscus* (Rodentia: Cricetidae) from the Pleistocene of Maryland: Carnegie Mus. Annals, v. 39, art. 6, p. 91–103, illus., tables, 1967.

Peromyscus cumberlandensis is described from cave deposits in Cumberland Cave in Allegany County. Sixty-four fragments of bones and teeth are present. Comparisons are made with other species within the genus and the distinguishing characters outlined. Another type, *Peromyscus(?)* sp. is also present in the same deposit.—HRC

04926 **Guilday, John E.** Notes on the Pleistocene big brown bat [*Eptesicus grandis* (Brown)]: Carnegie Mus. Annals, v. 39, art. 7, p. 105–114, illus., tables, 1967.

Eptesicus grandis, originally described from a fissure deposit in Arkansas, has since been reported from Pleistocene deposits in Maryland, West Virginia, Virginia, Pennsylvania, and Tennessee. Many specimens have been measured and the species seems indistinguishable from the modern bat *Eptesicus fulvus fulvus*. The local large-sized fauna could be a sexual factor (females are 5 percent larger) inasmuch as the sexes hibernate separately.—HRC

05077 **Guldenzopf, E. Charles.** The Glenwood–Platteville disconformity: Iowa Acad. Sci. Proc. 1965, v. 72, p. 305–311, illus., 1967.

Evidence for a disconformity between the Glenwood Member of the St. Peter Formation and the Pecatonica Member of the Platteville Formation is advanced. Physical lines of evidence are the presence of floating St. Peter sand grains and the presence of phosphate grains and pebbles in the basal Pecatonica at several localities in Iowa, Wisconsin and Illinois. Faunal evidence for a disconformity consists of the distribution of four conodont genera within these two units. *Chirognathus* spp. is found in the Glenwood and the basal Pecatonica, but no higher, while the genera *Polyplacognathus*, *Belodina* and *Eobelodina* first appear in the Pecatonica and are not found in the Glenwood. The presence of a "mixed fauna" at the base of the Pecatonica is taken as evidence of an erosion surface in which Glenwood conodonts have been reworked and redeposited along with Pecatonica forms.—Author's abstract

04922 **Guthrie, James O.; Robinson, Peter.** Geology of the northern portion of the Belchertown intrusive complex, Trip K *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ., Dept. Geology] p. 143–153, illus., table, geol. map, 1967.

The Belchertown intrusive complex is located immediately east of the Triassic border fault of the Connecticut Valley, and south of the Orange and Quabbin Reservoir areas. The main part of the complex is a roughly rectangular batholith of about 64 sq mi, emplaced into dome gneisses and metamorphosed Paleozoic rocks. The complex, probably Devonian in age, is the result of three episodes: initial intrusion of ultramafic bodies; main intrusion of the quartz diorite–granodiorite batholith and subsidiary stocks, with border breccia indicative of stoping; intrusion of aplite and pegmatite dikes. In the marginal zones, mineralogical changes and foliation and lineation parallel to those of the country rocks indicate that the batholith was intruded before the end of regional deformation and metamorphism. A table of point-counted modes is included.—VMJ

00017 **Gutman, Carlton W.** A many faceted jewel: Earth Sci., v. 21, no. 1, p. 5–7, illus., 1968.

Calcite crystallizes in over 700 recognized forms; the most complex habits have been reported from the Upper Peninsula of Michigan where they tend to form as isolated crystals of great perfection. Two periods of calcite formation have been recognized

in the Keweenaw Peninsula, separated by copper and datolite deposition. This interruption in crystal growth is sometimes marked by a coating of copper. A few of the easily recognizable forms are listed. Collectors also hunt crystals with irridescence along cleavage planes, twinning, striations and etching, and pseudomorphs. Most specimens found now are microsize.—ESL

04916 **Gutschick, R. C.; Canis, Wayne F.; Brill, Kenneth G., Jr.** Kinderhook (Mississippian) holothurian sclerites from Montana and Missouri: Jour. Paleontology, v. 41, no. 6, p. 1461–1480, illus., 1967.

Acetic acid residues contain elements of families Calclamnidae, Achistridae, Priscopedatidae, Theeliidae, Protocaudinidae, and Paleochiridotidae, commonly associated with echinodermal remains and several kinds of microfossils. Eight genera (one new) and 21 species (7 new) provide links among Early Mississippian Chouteau and Compton Limestones of Missouri, Lodgepole and Allan Mountain Limestones of Montana, Rockford Limestone and Jacobs Chapel Shale of Indiana, Escabrosa and Redwall Limestones of Arizona, and Chappel Limestone of Texas. The new genus and species are *Rotoides imperforata and R. tretomesota.* Other new species are *Eocaudina columcanthus, E. subhexagona, Achistrum coloculum, Priscopedatus spicaudina and Micorantyx mudgei.*—REG

05112 **Haas, John Lewis, Jr.** Solubility of iron in solutions coexisting with pyrite from 25° to 250°C, with geologic implications [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 862B, 1967.

05198 **Hadzeriga, Pablo.** Dynamic equilibria in the solar evaporation of the Great Salt Lake brine: Soc. Mining Engineers Trans., v. 238, no. 4, p. 413–419, illus., table, 1967.

Great Salt Lake brine was prepared using pure chemicals and subjected to a simulated solar evaporation in the laboratory; under the conditions used, the brine composition does not follow the Van't Hoff and D'Ans stable equilibria data for the system Cl^-, SO_4^{--}, Na^+, K^+, Mg^{++} and H_2O. Six evaporation studies simulated continuous solar evaporation; chemical analyses of the liquid phases, and optical properties of the solids obtained were determined under the polarized microscope. These studies proved that under dynamic solar evaporation conditions, the stable diagrams of the quinary system are not applicable for this brine. Confirmation of these preliminary results will be possible only by testing in an actual pond system.—*from* Author's summary

05227 **Hagar, David Jon.** Geomorphology of Coyote Valley, San Bernardino County, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1576B–1577B, 1967.

05055 **Ham, William E.; Wilson, James L.** Paleozoic epeirogeny and orogeny in the central United States, *in* Symposium on the chronology of tectonic movements in the United States: Am. Jour. Sci., v. 265, no. 5, p. 332–407, illus.,1967.

The central United States, between the Rocky and Appalachian Mountains, is largely cratonic with Paleozoic tectonism limited to epeirogenesis. Orogenic movements, confined to the Ouachita system and the Anadarko–Ardmore basin, occurred in Pennsylvanian and Permian time. A series of paleogeologic maps and a graphical summary of tectonic history and sedimentary record for the major structural elements of the central United States are included.

05253 **Hamil, Brenton McCreary.** Trace elements in accessory magnetite from Basin and Range quartz monzonites [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1548B, 1967.

Hand, Bryce M. *See* Wessel, James M. 04923

Handley, Charles O., Jr. *See* Guilday, John E. 04925

05121 **Hansuld, John A.** Eh and pH in geochemical prospecting, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 172-187, illus., 1967.

This paper discusses the concept of Eh and pH and demonstrates, with the aid of some diagrams, some applications to geochemical prospecting, especially applied to the oxidation of sulfides and the mobility of metal ions in geologic environments. It is emphasized that the application of Eh and pH to geochemical exploration is still quite new and many assumptions must be made resulting in over-simplifications. If used within their limitations, they provide, however, a means of detecting the laws governing the observed abundances, distribution, and migration of the elements.—MST

Hardman, Elwood. *See* Cook, Kenneth L. 04940

05206 **Harksen, J. C.** Quaternary loess in southwestern South Dakota: South Dakota Acad. Sci. Proc. 1967, v. 46, p. 32-40, illus., 1967.

During the Quaternary the unglaciated area of the northern Great Plains was the depositional site for great amounts of eolian material, including loess; this loess extends also into western South Dakota. The major reason for the small amount of loess in South Dakota compared with that in Nebraska is not so much lack of deposition as a greater amount of Quaternary erosion in South Dakota. The White River Badlands, a semiarid region of exposed Tertiary sediments, is an ideal source area for the loess deposited in Shannon, Bennett, and Washabaugh Counties. Remnants of the Sand Hills Formation in parts of the Badlands area might be a residue left behind when wind removed the smaller particles of the White River or Arikaree Groups.—MST

05045 **Harrington, John W.** The first, first principles of geology: Am. Jour. Sci., v. 265, no. 6, p. 449-461, illus., 1967.

About 24 centuries ago Herodotus made some remarkable field observations on the work of the Nile River in Egypt. He understood enough of the first principles of geology to be able to communicate with us today on a scientific basis. His first principles were: Nature can be analyzed and understood by 1) collecting facts as field observations, classifying them on a meaningful basis and correlating them for use by a) searching out general or universal characteristic and relating classes of phenomena; b) recognizing that an observed fact existed throughout a range of past time; and 2) understanding causality and realizing that properly assembled facts imply rational, inescapable conclusions that cannot be found as simple observations.—*from* Author's abstract

05197 **Harris, D. P.** Operations research and regional mineral exploration: Soc. Mining Engineers Trans., v. 238, no. 4, p. 450-459, illus., 1967.

This paper surveys a few of the quantitative exploration models that might be of interest to an explorationist seeking to apply methods of operations research to mineral exploration. A general development of each model is presented, and the model is evaluated relative to the exploration activity. Finally a philosophy of exploration and mineral resources is presented, and a possible exploration strategy incorporating concepts of some of these models consistent with this philosophy is proposed.—Author's abstract

05171 **Harrison, W. W.; Caufield, K.** Line sources in absorption spectroscopy [with French and German abs.]: Anal. Chim. Acta, v. 39, no. 2, p. 161-166, illus., 1967.

Hollow-cathode tubes and discharge lamps are studied as spectral sources for absorption spectrophotometry. Comparisons are made of monochromatic *versus* conventional continuous sources with respect to several experimental parameters, particularly the effect of slitwidth. Working curves are shown to indicate the possible advantages of using line sources for narrow band absorption systems.—Authors' abstract

05389 **Hart, Earl W.** Letter to the editor [discussion of AAPG correlation sections, 1967]: Pacific Petroleum Geologist, v. 21, no. 12, p. 3, 1967.

As geologic names editor for the California Div. Mines and Geology, Hart believes that a greater effort can be made to apply the Code of Stratigraphic Nomenclature to subsurface stratigraphic units. The most important step is to distinguish between *formal* and *informal* terminology. Informal designations apply largely to units commonly of local interest and often having an economic connotation, or stratigraphic units not adequately (formally) described in the published literature. Distinguishing between them can be accomplished by capitalizing the first letter of each designation (Markley Formation, etc.) for formal units, and lower casing them for informal (Salinas River gravel).—MCM

04917 **Hartshorn, Joseph H.; Colton, Roger B.** Geology of the southern part of glacial Lake Hitchcock and associated deposits, Trip E *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ., Dept. Geology] p. 73–88, illus., 1967.

Geologic features of the southern part of Pleistocene glacial Lake Hitchcock are observed in a field trip following the Connecticut Valley between Middletown, Conn., and Amherst, Mass. A mile-wide dam of stratified drift was deposited as a series of coalescent deltas across the Connecticut Valley at Rocky Hill, north of Middletown, when the ice front retreated following the Middletown readvance about 14,000 years ago. The lake increased in length to about 150 miles as the ice front retreated northward. Several lake stages are represented by beaches, spillways, delta deposits of glacial tributary streams, and varved clay bottom deposits. Glacial Lake Hitchcock was finally drained when the Rocky Hill dam was breached by headward erosion about 10,700 years ago. Postglacial upwarping of 4.2 feet per mile took place, as indicated by shorelines rising to the north.—VMJ

05078 **Hase, D. H.** Geologic interpretation of magnetic map, Keokuk County, Iowa: Iowa Acad. Sci. Proc. 1965, v. 72, p. 311–316, illus., 1967.

In 1964, surface measurements of the vertical component of the Earth's magnetic field were made in Keokuk County, Iowa. The geologic conditions responsible for the magnetic anomalies can be attributed almost entirely to changes in the lithology of the Precambrian crystalline basement complex about which no direct information is available. The basement complex probably includes granitic, basic igneous and/or metavolcanic rocks, and the estimated depth to the top of the complex is about 3,000 feet. There is little correlation between the magnetic anomalies and known Paleozoic structures, but knowledge of the structures is very limited.—Author's abstract

Haskell, R. E. *See* Edwards, J. M. 04895

04896 **Hatch, Norman L., Jr.; Osberg, Philip H.; Norton, Stephen A.** Stratigraphy and structure of the east limb of the Berkshire anticlinorium, Trip A *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ., Dept. Geology] p. 7–16, illus., 1967.

The Berkshire anticlinorium in northwestern Massachusetts consists of a Precambrian core of crystalline gneisses overlain on the east and west limbs by metamorphosed Paleozoic rocks. On this field trip, the stratigraphy and structure of the rocks of the east limb, a eugeosynclinal sequence of Cambrian to Devonian schists and gneisses, are examined in a roughly west-to-east traverse between Savoy and Cummington. Formations from the Hoosac to the Goshen are described briefly, and rock units of the area (current mapping and B. K. Emerson's units) are correlated with the rocks of New Hampshire and Vermont.—VMJ

05228 **Hausen, Donald Martin.** Fine gold occurrence at Carlin, Nevada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1577B, 1967.

05068 **Hawkes, H. E.** Geochemical evidence on the origin of the Lonar Crater, Maharashtra, India—Discussion [of paper by V. Venkatesh, 1965]: Geol. Soc. America Bull., v. 78, no. 9, p. 1199–1200, table, 1967.

Experimental sampling at the Canyon Diablo crater, Arizona, does not support the suggestion [Venkatesh, ibid., v. 76, p. 1315–1316, 1965] that nickel content of soils and plants can be used as evidence for the meteoritic origin of a crater.—Author's abstract

Hawkes, H. E. *See* Friedrich, G. H. 05100

05036 **Hawkins, James W., Jr.** Prehnite–pumpellyite facies metamorphism of a graywacke–shale series, Mount Olympus, Washington: Am. Jour. Sci., v. 265, no. 9, p. 798–818, illus., tables, 1967.

In the core of the Olympic Mountains, a mineral assemblage of prehnite–albite–quartz–chlorite–phengitic mica and locally calcite–pumpellyite–sphene–opaque ore indicate load metamorphism at a probable temperature of 300°C and pressure of 3kb with $P_{water} = P_{total}$ of the pre–Tertiary(?) feldspathic graywackes and petromict conglomerates and shales. Prehnite in unsheared graywacke and veins indicates load metamorphism, but prehnite in synkinematic mineral assemblages and in shears suggests that locally deformation promoted its formation. The apparent lack of zeolite or prehnite–pumpellyite facies minerals in lower Tertiary clastic rocks around the Olympus area suggests the core rocks are separated from the surrounding rocks by a major tectonic and(or) stratigraphic unconformity, giving support to the pre–Tertiary angular unconformity suggested by Weaver (1937) and Danner (1955).—RWT

04907 **Hay, William W.; Mohler, Hans P.** Calcareous nannoplankton from early Tertiary Rocks at Pont Labau, France, and Paleocene–Early Eocene correlations: Jour. Paleontology, v. 41, no. 6; p. 1505–1541, illus., 1967.

Well–preserved assemblages of calcareous nannofossils are found in Paleocene–early Eocene pelagic sediments on the north flank of the Pyrenees south of Pau, Basses Pyrenees, France. Nearly continuous exposures through the Paleocene strata at Pont Labau provide a reference section for correlation with othr localities in Europe and the Americas.—*from* Authors' abstract

Hayes, Miles O. *See* Wessel, James M. 04923

00029 **Hayes, Philip T.; Raup, Robert B.** Geologic map of the Huachuca and Mustang Mountains, southeastern Arizona: U.S. Geol. Survey Misc. Geol. Inv. Map I–509, scale 1:48,000, sections, 1968.

05111 **Hayes, Philip T.** Huachuca Quartz Monzonite, Huachuca Mountains, Cochise County, Arizona, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1966: U.S. Geol. Survey Bull. 1254–A, p. A29, illus., 1967.

Haygarth, John. *See* Matsushima, Shogo. 04946

Haynes, C. Vance, Jr. *See* Mehringer, Peter J., Jr. 05044

Hedge, Carl E. *See* Peterman, Zell E. 05314

Heezen, Bruce C. *See* Rona, Peter A. 05161

Heezen, Bruce C. *See* Schneider, Eric D. 05425

04891 **Helander, Donald P.; Graves, Roy W.; Martinez, S. J.** Sources of "lost" information for log analysts, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. G1–G19, illus., tables, 1967.

The value of new technical information constantly being published is great but, unfortunately, many valuable articles are not readily available to the log analyst,

or he is not aware of their publication and overlooks them. Rather than pursue a hit or miss system of locating new knowledge or retrieval of older data from voluminous files, the log analyst should make use of newly developed facilities in the information field. Abstracting services encapsulate current technical output in a form that makes it possible to review large quantities of material. Special indexing systems and searching tools make it possible to locate published information in a very short time. A description of the various information retrieval systems currently available to the log analyst is included.—*from* Authors' abstract

Helin, Eleanor. *See* Nichiporuk, Walter. 05404

05250 **Helmberger, Donald Vincent.** Head waves from the oceanic Mohorovičić discontinuity [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1586B, 1967.

05283 **Helwig, James.** Paleogeomorphology and its application to exploration for oil and gas (with examples from western Canada)—Discussion [of paper by R. Martin, 1966]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2468, 1967.

Caves originate in phreatic zone, not vadose zone as indicated by Martin (ibid., v. 50, no. 10, p. 2277–2311, 1966).—WCC

Hem, John D. *See* Durum, Walton H. 05268

05138 **Hemley, J. J.** Aqueous solutions and hydrothermal activity, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 647–653, 1967.

Work on methods for estimating ion entropies and other thermodynamic properties at higher temperatures has been of particular geochemical significance in 1963–66. Heat capacity and entropy relationships have been the properties most thoroughly investigated to date, and these areas provide new avenues of approach in evaluating free energy relations at higher temperatures. Solubility studies occupied many geologists and geochemists. Laboratory–field investigations tied to specific areas or occurrences have yielded important information. Studies on natural hydrothermal systems have continued. One of the most exciting developments is the discovery of a subsurface hydrothermal brine of unusually high metal content in the Salton Sea area. An extensive bibliography is given.—DBV

Henderson, E. *See* Fuchs, Louis H. 05397

05373 **Henderson, J. F.** (compiler). Current research in the geological sciences in Canada, 1966–67—Natl. Advisory Comm. Research in Geol. Sci.: Canada Geol. Survey Paper 67–58, 179 p., 1967.

In this bibliography, research projects are grouped under the headings: areal geology engineering geology, geochemistry, geochronology, geophysics, geomorphology and glaciology, mineral deposits, mineralogy, paleontology, petrology and petrography, Pleistocene and ground water, sedimentation, stratigraphy and paleontology, and structural geology. An author index is included.—ESL

05003 **Heroux, Robert.** Chandler, carte des depôts superficiels [abs.]: Assoc. Canadienne–Française Av. Sci. Annales 1965–66, v. 33, p. 99, 1967.

05015 **Héroux, Robert.** Géomorphologie de la région de New–Carlisle (Gaspésie) [abs.]: Assoc. Canadienne–Française Av. Sci. Annales 1965–66, v. 33, p. 97, 1967.

05147 **Herrin, Eugene.** Travel times and amplitudes of body waves, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 403–407, 1967.

The availability of large explosions has been the greatest single factor leading to improved knowledge of P-wave traveltimes and velocity structure. With improved resolution it is now possible to search for lateral variations in the lower mantle. One of the most interesting new techniques involves the use of large arrays to

determine directly the derivation of the traveltime function and to study later arrivals in the P-wave train; this promises to provide detailed information on upper mantle structure impossible to obtain from studies of first arrivals alone. A bibliography of pertinent works is given.—DBV

Hershey, Garland. *See* Coons, Richard L. 05281

05398 **Heymann, Dieter; Anders, Edward.** Meteorites with short cosmic-ray exposure ages, as determined from their Al^{26} content, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1793–1809, illus., tables, 1967.

The Al-26 content was determined by γ-γ coincidence spectrometry in 31 stony meteorites: 10 carbonaceous, 4 enstatite, 3 bronzite, 5 hypersthene and 5 amphoteric chondrites; 1 angrite, 1 eucrite, 1 ureilite and 1 diogenite. In the following meteorites, the Al-26 content was low enough to determine cosmic-ray exposure age (million years): Ivuna 0.18 ± 0.05, Cold Bokkeveld 0.32 ± 0.04, Nogoya 0.14 ± 0.08, Pollen 1.0 ± 0.5, Grosnaja 1.5 ± 0.4, St. Marks 0.9 ± 0.2, Shaw 0.40 ± 0.07, Appley Bridge 1.5 ± 0.5. The mean Al-26 content found for 16 samples of ordinary and enstatite chondrites is 63 dpm/kg, appreciably higher than the value of 47 dpm/kg determined by means of γ-ray spectrometry (Rowe et al., 1963).—*from* Authors' abstract

05326 **Hickey, Leo Joseph.** The paleobotany and stratigraphy of the Golden Valley Formation in western North Dakota [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 2, p. 742B, 1967.

05229 **High, Lee Rawdon, Jr.** Recent coastal sediments of British Honduras [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1577B, 1967.

Hills, David L. *See* Walton, William C. 05384

04955 **Hobbs, P. V.; Radke, L. F.** The role of volume diffusion in the metamorphism of snow [with French and German abs.]: Jour. Glaciology, v. 6, no. 48, p. 879–891, illus., 1967.

A theoretical expression is derived for the rate of increase in the density of a compact of uniform ice spheres due to volume diffusion in the ice. The diffusion occurs due to the existence of high concentrations of vacancies in the ice just beneath the concave surfaces of the necks which grow between the ice spheres. Accurate measurements on the densification of a compact of ice spheres as a function of time, temperature, and particle size are found to be in excellent agreement with the theory. The importance of this process in the metamorphism of dry snow at uniform temperatures is discussed.—Authors' abstract

Hobbs, P. V. *See* Radke, L. F. 04956

Hollister, Charles D. *See* Schneider, Eric D. 05425

Honea, R. M. *See* Strangway, D. W. 05426

00008 **Hooker, Marjorie.** Mineralogy: Geotimes, v. 13, no. 1, p. 15, 1968.

The New Minerals and Mineral Names Commission of the International Mineralogical Association, responsible for establishing criteria for new minerals and acting as a clearing house for information on these minerals, has set up procedures to consider mineral names and data prior to publication, and thereby exclude unjustified names from the literature. It is concerned also with nomenclature revision to reach agreement on names and eliminate synonyms. The decisions voted during 1961–1964 published in the Mineralogical Magazine, March 1967, indicate its growing importance and success.—MH

05286 **Hopkins, Richard H.** Critical analysis of stack seismic systems—Discussion [of paper by L. E. Nugent, 1967]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2475, 1967.

In discussion of Nugent's paper (ibid., v. 51, no. 6, p. 951–956, 1967) Hopkins points out that errors due to "stretch" of common depth point are negligible at depth.—WCC

Hopkinson, E. C. *See* Wichmann, P. A. 04974

Hornbrook, E. H. W. *See* Fortescue, J. A. C. 05125

04969 **Horvath, Allan L.** Relationships of Lower Silurian strata in Ohio, West Virginia, and northern Kentucky: Ohio Jour. Sci., v. 67, no. 6, p. 341–359, illus., 1967.

The Brassfield Formation thickens eastward into the subsurface and a wedge of shale and carbonate rocks separate it from the overlying Dayton Formation. This wedge is the middle and lower part of the Noland Formation. The Noland, in the subsurface, continues to Guernsey County, Ohio. The lower Plum Creek Member of the Noland continues northward into Ontario where it is called the Cabot Head Shale. The Brassfield Formation, in the subsurface, becomes the Manitoulin Dolomite in Ontario. Eastward, the Brassfield and Plum Creek intertongue with the "Clinton" sandstone to the northeast, and with the Tuscarora Formation to the southeast. The rest of the Noland merges eastward into the Rose Hill Formation.—*from* Author's abstract

05390 **Horvath, Allan L.** A teacher's legacy—Dr. August F. Foerste [1862–1936]: Explorer, v. 9, no. 4, p. 20–22, illus., 1967.

04966 **Howard, Arthur David.** Drainage analysis in geologic interpretation—A summation: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2246–2259, illus., table, 1967.

Drainage analysis is useful in structural interpretation, particularly in areas of low relief. It considers drainage patterns, texture, and anomalies, and individual stream pattern. Drainage patterns generally are subdivided into basic and modified basic. To these might be added pattern varieties. Drainage texture depends on a variety of factors. In any one small area where other factors are constant, texture may provide information on underlying materials, and indirectly on structure. Drainage anomalies indicate departures from the regional geologic or topographic control.—WCC

05050 **Howarth, R. J.** Trend-surface fitting to random data—An experimental test: Am. Jour. Sci., v. 265, no. 7, p. 619–625, illus., tables, 1967.

The percentage sum of squares accounted for by linear, quadratic, or cubic trend-surfaces is a commonly used measure of their reliability in extracting the regional trend "inherent" in the variation of a mapped variable with geographic coordinates. Sixty experimental tests of fitting such surfaces to randomly distributed data suggest that if the sum of squares test produces values that fall below 6.0, 12.0, and 16.2 percent for the linear, quadratic, and cubic surfaces, respectively, the distribution of data points is not significantly different from random at the 0.05 level.—Author's abstract

Howell, Benjamin F., Jr. *See* Leblanc, Gabriel. 05357

Hoyle, W. R. *See* Schmidt, A. W. 04991

Hsieh, S. *See* Crocket, J. H. 05422

04964 **Hubbert, M. King.** Degree of advancement of petroleum exploration in United States: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2207–2227, illus., 1967.

Oil and gas are exhaustible resources; discovery and production history must, therefore, show a beginning, a period of increase, a peak, a period of decline, and an end. Analyses of three suites of diagnostic data (1860 to 1966) indicate that the peak in the rate of proved discovery occurred about 1956; the peak in proved reserves, about 1961; and the peak in production rate should occur before 1970.

Total crude oil ultimately to be discovered in the U.S. will be less than 200 billion bbl; ultimate cumulative crude-oil production from fields already discovered in the conterminous U.S. by the end of 1966 will be about 136 billion bbl, or 68 to 85 percent of the total. The discovery rate, in terms of bbl/ft of exploratory drilling, has declined precipitously from a peak of 276 bbl/ft (1929–1937) to a present rate of 35 bbl/ft. Higher estimates of total oil to be discovered require a discovery rate in excess of 80 bbl/ft.—BHK

04977 **Hudson, Donald E.** Instrumental data on strong earthquake ground motions: Eng. Geology, v. 4, no. 2, p. 31–41, illus., 1967.

Strong-motion accelerographs have special characteristics and requirements. The influence of the local geological site on the ground accelerations is important. Information derived from a study of the accelerograms of past strong earthquakes is summarized: (a) maximum ground acceleration on firm alluvium in the epicentral region of strong earthquakes is of the order of 0.5 g; (b) maximum time duration of heavy ground shaking on firm alluvium is of the order of 45 seconds; (c) for a given typical site, earthquake energy must be assumed to be distributed uniformly over a wide frequency spectrum; and (d) local geological and soil conditions may in special cases influence significantly the ground motion frequency characteristics.—*from* Author's abstract

Hurley, P. M. *See* Fairbairn, H. W. 05331

05350 **Hutchison, W. W.** Geothermometry from changes in stress birefringence around inclusions in garnet during heating to 900°C: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1171–1184, illus., tables, 1967.

Some changes in birefringence are due to fit-misfit relationships of inclusions. Some garnets appear to have behaved as natural bombs, which have carefully preserved the misfit relationships since crystallization. This combination can be used to determine the temperatures of fit at room temperature; the intersection of curves of fit (on a P–T plot) can be employed to determine possible temperatures and pressure of formation. In addition, changes in birefringence around inclusions of quartz reveal whether the garnet (or quartz inclusion) crystallized above or below the α–β quartz inversion. This technique is limited chiefly by lack of P–V–T data on minerals.—*fom* Author's abstract

05230 **Hyndman, Donald William.** Petrology and structure of Nakusp map-area, British Columbia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1578B, 1967.

Ito, Keisuke. *See* Cohen, Lewis H. 05046

05047 **Ito, Keisuke; Kennedy, George C.** Melting and phase relations in a natural peridotite to 40 kilobars: Am. Jour. Sci., v. 265, no. 6, p. 519–538, illus., tables, 1967.

Melting interval and phase equilibria of a garnet peridotite nodule were investigated. The lower pressure–high temperature stable assemblage is olivine + orthopyroxene + clinopyroxene + chrome-spinel. The high pressure–low temperature stable assemblage is olivine + orthopyroxene + clinopyroxene + garnet. Spinel coexists with garnet in a transition zone. Garnet appears at 23 kilobars on the solidus. The transition from spinel peridotite to garnet peridotite may occur at shallow depth in the mantle under the ocean, but spinel peridotite probably is unstable under the continental shield. The solidus of the peridotite is almost identical with recent determinations of the solidus of basalt and eclogite.—*from* Authors' abstract

05192 **Ives, J. D.** Glacial terminal and lateral features in northeast Baffin Island—Illustrations with descriptive notes [with French abs.]: Canada Dept. Energy, Mines and Resources Geog. Br. Geog. Bull., v. 9, no. 2, p. 106–114, illus., 1967.

This is the second of two short papers giving illustrations of glacial forms in northeast Baffin Island. Ten photographs are reproduced to show terminal and lateral sections of five different glaciers. Descriptive notes are added and attention

is drawn to the value of examining features in an active state of formation as a means of assisting in the interpretation of fossil forms.—Author's abstract

05401 **Jaeger, Ralph R.; Lipschutz, Michael E.** Implications of shock effects in iron meteorites, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1811–1832, illus., table, 1967.

Microscopic and X-ray diffraction studies of the shock history of 65 octahedrites are reported. Conclusions suggested by the results of the study are: (1) A single collision 650 ± 60 10^6 yr ago was responsible for a majority of these shocked meteorites. (2) One of the partners in this collision seems to have been a Ring asteroid and the parent of the Ga–Ge group III octahedrites. (3) The more massive partner in this collision may be the parent of the hypersthene chondrites. Possibly, it too was a Ring asteroid although its orbit may have crossed that of Mars. (4) This postulated collision also appears to account for the predominance of the hypersthene chondrites and medium octahedrites among meteoritic falls and finds.—*from* Authors' abstract

04924 **Jahns, Richard H.** The Late Pleistocene of the Connecticut Valley in northern Massachusetts, Trip M *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ., Dept. Geology] p. 167–194, illus., 1967.

Late Pleistocene and early postglacial features and deposits of the Connecticut Valley Lowland between the Holyoke Range and the northern border of Massachusetts are observed, and their complex history interpreted. Glacial tills of two stratigraphic groups, possibly representing different glaciations, overlie the bedrock of the valley floor and bordering highlands. Recession of the last ice sheet is represented by: ice-contact outwash deposits of streams and ponds at different levels (pre-lake period); ice-contact outwash, deltaic outwash, and bottom sediments of proglacial Lake Hitchcock, which enlarged progressively northward to occupy almost the entire lowland area. The ice-free period is represented by terrace and fluvial deposits associated with drainage of Lake Hitchcock and by postglacial sand dunes.—VMJ

05300 **Jeffers, J. W.** Memorial to Edwin Leslie Trice, Jr. (1929–1967): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2316, portrait, 1967.

04887 **Jeffries, F.** Reservoir volume calculations with a well data system, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. A1–A17, illus., tables, 1967.

Several Devonian reef fields in Alberta are used as examples. Input tapes are of three kinds: general well data, log interpretation (gamma, acoustic, caliper, and resistivity), and core analysis (plug-by-plug records of depth intervals, plug thickness, porosity, vertical permeability, two horizontal permeabilities, density lithologic code, and quality codes). Cutoff values of 3 percent core porosity and 0.2 millidarcies permeability were used to determine net pay. Various other cutoff techniques and problems are explained. A program can select pertinent data and plot it geographically, and contour maps of porosity values above O/W, and relative porosity feet can be made. Since much of the data evaluation is routine, the engineer's time can be put to more productive enterprise.—HRC

Jérome, Dominique Y. *See* Goles, Gordon G. 05399

05261 **Johnson, A. I.** Groundwater, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 711–724, 1967.

Much has been accomplished during 1963–66 in the field of ground water—in data collection and investigative programs, research, and training of manpower. An extensive list of references (almost 9 pages) is given which represents a cross section of papers and reports on ground water since 1963.—DBV

05163 **Johnson, Donald Lee.** Caliche on the Channel Islands: California Div. Mines and Geology Mineral Inf. Service, v. 20, no. 12, p. 151–158, illus., 1967.

The term caliche is defined, and the material described; it usually conforms to topography rather than bedding. Its surface expression on the four outermost Channel Islands is unique and takes shapes resembling fossil forests. Research suggests a long evolution beginning perhaps 100,000 years ago. During the Wisconsin calcareous sand blew inland and became indurated dune rock; stable and unstable periods alternated, buried tree trunks formed caliche casts, and a hard caliche layer formed in the subsoil. Two main types of caliche are described—soil caliche and eolinite. Four factors responsible for formation of eolinite only on the outermost islands are: strong and directly onshore winds, coastal conformation permitting large carbonate biomass concentrations, a widely exposed continental shelf to windward of the coast, and an absence of mountainous terrain inland.—ESL

00023 **Johnson, Edward L.** Summary report on the geology and mineral resources of the Charons Garden Unit, Wichita Mountains National Wildlife Refuge, Comanche County, Oklahoma: U.S. Geol. Survey Bull. 1260-J, p. J1-J7, illus., 1968.

The Charons Garden Unit, about 5,000 acres, and a candidate area for inclusion in the National Wilderness Preservation System, is near the center of the Wichita Mts. and almost everywhere is underlain by granite. No deposits of minerals subject to mineral leasing laws are known; the presence of commercial deposits is extremely unlikely. Granite suitable for monumental and building stone undoubtedly can be found, but such stone is widely available and more accessible elsewhere.—*from* Author's abstract

05315 **Johnson, G. Leonard.** North Atlantic fracture zones near 53°: Earth and Planetary Sci. Letters, v. 2, no. 5, p. 445-448, illus., 1967.

Near 53°N the crest of the Mid-Atlantic Ridge is offset 370 km in a left lateral sense by a large fault. Smaller subsidiary and parallel fracture zones are found both to the north and south of the primary fault. There is no magnetic signature associated with the fracture zone.—Author's abstract

05081 **Johnson, Gary D.; Garside, Larry J.; Warner, Albert J.** A study of the structure and associated features of Sheep Mountain Anticline, Big Horn County, Wyoming: Iowa Acad. Sci. Proc. 1965, v. 72, p. 332-342, illus., table, 1967.

A study was made of the joint sets developed within two stratigraphic units of significantly different ages in the Sheep Mountain region, Big Horn County, Wyoming, in an attempt to determine if any pre-Laramide orogeny existed in the area. The field methods used and the relationships exhibited between joint sets are discussed. From the data presented, no significant support of the premise is concluded.—Authors' abstract

04890 **Jones, Bob.** Case histories of subsurface log data exploration patterns in eastern Powder River basin, Wyoming, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. E1-E16, illus., 1967.

A brief history of log evaluation is presented through Cretaceous Newcastle Formation production to the Dakota and Minnelusa Formation discoveries and development phases. Derivation and interpretation of water resistivities are discussed as they existed prior to discovery and as they appear following development; the presence and importance of water resistivity gradients are emphasized. Six of the production examples were chosen from a regional study which yielded 46 prospective exploration areas, 14 or 30.0 percent of which are now productive from one or more horizons. Although support data for mapping these examples was derived from the Dakota Formation, several of the areas were found to be productive from the Minnelusa sands of Permian and Pennsylvanian age. The region is thereby demonstrated to contain vertically anomalous conditions of formation entrapment.—*from* Author's abstract

Jordan, C. *See* Cole, A. J. 05411

05364 **Jordan, Louise.** Geology of Oklahoma—A summary: Oklahoma Geology Notes, v. 27, no. 12, p. 215-228, illus., reprinted 1967; originally published [1966?].

This summary has been written at the request of the Geophysical Society of Tulsa as an aid in understanding the major geophysical anomalies shown on the magnetic and gravity maps of Oklahoma (V. L. Jones, Oklahoma Geol. Survey Map GM-6, 1964; P. L. Lyons, ibid., Map GM-7, 1964); these maps also accompany papers by the same authors *in* Geophys. Soc. Tulsa Proc. 1961-64, v. 8 [1966?]. Stratigraphy of Precambrian through Cretaceous rocks, major unconformities and structure, and present land surface are summarized (geology of the Panhandle is omitted). Accompanying generalized maps show: geology, paleogeology (pre-Pennsylvanian, pre-Mississippian), major structural features and provinces, and generalized contours of basement rocks.—VMJ

05251 **Kashirad, Ahmad.** Characterization of tillage pans in selected coastal plain soils [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1314B-1315B, 1967.

05231 **Katz, Michael Barry.** The nature and origin of the granulites of the southern part of Mont Tremblant Park, Quebec [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1578B, 1967.

05140 **Kaula, W. M.** Goedetic satellites—Evaluation of results relative to those obtained by other means, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 343-345, 1967.

The respects in which results of satellite geodesy can be compared with other determinations, and some approximate accuracies attained, are reviewed. More accurate global representation of the gravity field has stimulated comparison with other geophysical variables. The slight or even negative correlation of gravity with topography has been confirmed for continental-oceanic scale variations; for more regional variations the correlation is definitely positive. There is a significant correlation between gravity and heat flow, and possibly with geologic structure. A bibliography of pertinent works is given.—DBV

Keays, R. R. *See* Crocket, J. H. 05422

Kelling, Gilbert. *See* Gross, M. Grant. 00006

Kellogg, William C. *See* Elliott, C. L. 05396

05102 **Kelly, R. W.; Assad, R.** Geochemical prospecting for molybdenum—A case history in the Mount Ste-Cecile area, Frontenac County, Quebec [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 271-272, 1967.

05083 **Kemp, Paul J.; Elwell, James H.** Determining the relative shear behavior of coarse concrete aggregate and associated matrix: Iowa Acad. Sci. Proc. 1965, v. 72, p. 351-356, illus., 1967.

A study of the bond characteristics of carbonate aggregates was made by applying shear stresses to 1/8-inch thick slices of highway concrete. It was found that aggregates can be classified as strong, indeterminate, and weak relative to the matrix of the concrete, when accurate lithological cataloging of the aggregates from the source quarry section is made prior to the shear study. Definite classification can only be made in older concretes (7-15 years in age) since newer concretes tend to fail in the aggregate-matrix bond zone, making it difficult to observe the relative aggregate strength. The method provides a basis for further study of the aggregates as classified, and a basis for correlating important factors revealed by the studies with the observed quality. Such studies might then be extrapolated to evaluate other quarry sections.—Authors' abstract

Kennedy, George C. *See* Matsushima, Shogo. 04946

Kennedy, George C. *See* Kitahara, S. 05037

Kennedy, George C. *See* Cohen, Lewis H. 05046

Kennedy, George C. *See* Ito, Keisuke. 05047

05276 **Kenney, T. C.** The influence of mineral composition on the residual strength of natural soils [with French abs.], *in* On shear strength properties of natural soils and rocks—Geotech. Conf., Oslo, 1967, Proc.: Oslo, Norway, Norwegian Geotech. Inst., p. 123–129, illus., table, 1967.

Drained direct-shear tests on natural soils, pure minerals and mineral mixtures have shown that residual shear strength is primarily dependent on mineral composition and is not related to plasticity or to grain-size characteristics. Massive minerals, such as quartz, feldspar and calcite, exhibit $tg\phi res > 0.58$ ($\phi res > 30°$); micaceous minerals, such as hydrous mica, exhibit $tg\phi res > 0.30$ ($\phi res > 17°$); montmorillonitic minerals exhibit $tg\phi res < 0.20$ ($\phi < 11°$). Hence, soils that could be expected to have small residual strengths are those containing montmorillonitic minerals; soils that contain primarily micaceous minerals and massive minerals could be expected to have larger residual strengths. Rate of strain had little influence on residual strength.—*fom* Author's summary

05293 **Kenney, T. C.** Field measurements of in situ stresses in quick clays [with French abs.], *in* On shear strength properties of natural soils and rocks—Geotech. Conf., Oslo, 1967, Proc.: Oslo, Norway, Norwegian Geotech. Inst., p. 49–55, illus., 1967.

Many aspects of shear-strength behaviour of natural quick clays are dependent on the relative magnitude of the in-situ principal effective stresses. An apparatus to measure horizontal stresses, and that consisted of a large open pipe instrumented with earth-pressure and water-pressure gauges, was constructed and installed at three different sites in such a way that the pipe did not displace the clay outwards from the pipe. The maximum value of the ratio between horizontal and vertical effective stresses was $K \approx 0.65$. Disturbance of the clay in contact with the pipe influenced the magnitudes of the measured earth pressures.—Author's summary

04905 **Kent, Harry C.** Microfossils from the Niobrara Formation (Cretaceous) and equivalent strata in northern and western Colorado: Jour. Paleontology, v. 41, no. 6, p. 1433–1456, illus., 1967.

Foraminifera serve to divide the Niobrara Formation (Upper Cretaceous) and the equivalent portion of the Mancos Shale in Colorado into two biostratigraphic subdivisions. Three new species and one new subspecies of Foraminifera as well as 27 previously-described species of Foraminifera and one previously-described species of Radiolaria have been recognized. The lower portion of the strata, informally termed the *Globorotalites* interval, is characterized by a variety of benthonic calcareous forms, notably species of *Globorotalites* and *Pleurostomella*. The upper part of the section, informally termed the *Gavelinella* interval, contains a more limited microfauna particularly characterized by the presence of some species of *Gavelinella*, notably *G.talaria*.—*from* Author's abstract

05335 **Kerr, J. William.** A submerged continental remnant beneath the Labrador Sea: Earth and Planetary Sci. Letters, v. 2, no. 4, p. 283–289, illus., 1967.

It is proposed that lands between Greenland and Canada are remnants left as the two larger land masses became separated by continental drift, which involved three separate mechanisms: continental extension (stretching), simple continental rotation, and isolation of a submerged continental remnant. Reconstruction of northeastern North America prior to drift reveals a missing piece of continental crust in the Labrador Sea. It is suggested here that a submerged continental remnant of the type suggested by Carey (a short-lived rising remnant isolated between sloping outward shear zones) exists beneath the Labrador Sea. Possibly such remnants may exist beneath the full length of all midocean ridges.—VSN

04894 **Keys, W. Scott.** Well logging in ground-water hydrology, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. K1–K21, illus., 1967.

The application of geophysical well logging to ground-water hydrology is comparable to its use in petroleum exploration in the 1930's. The equipment and

techniques of the oil industry can be adapted for use in the water industry. The expense must be reduced to make logging practical for use with water wells. This can be accomplished because water wells are not so deep, and temperatures and pressures are lower. The following techniques are being used by the U.S. Geological Survey in ground water investigations: SP, resistivity, gamma, gamma-gamma, neutron, radioactive tracer, flowmeter, caliper, fluid resistivity, gradient and differential temperatures, and sonic velocity. Lightweight sondes have been developed, as has an inexpensive magnetic tape system.—*from* Author's abstract

Kimberlin, Jerome. *See* Wasson, John T. 05408

05136 **King, Philip B.** (compiler). National Atlas—Sheets 69–70, Tectonic features: Washington, D.C., U.S. Geol. Survey, scale 1:7,500,000, text, 1967.

On the tectonic map of the 48 conterminous states, the arrangement of colors and symbols brings out two contrasting kinds of regions—platform areas and foldbelts—which are explained in detail in the text. Tectonic features of Hawaii are shown on an inset on sheet 70, those of Alaska on sheet 69.—MCM

05210 **King-Hele, Desmond.** The shape of the earth: Sci. American, v. 217, no. 4, p. 67–76, illus., 1967.

Between the time of Pythagoras and the launching of *Sputnik I* in 1957, man determined the spherical nature and size of the Earth and the order of magnitude of polar flattening of the geoid. Observations of the orbits of artificial satellites show that the polar flattening is slightly less than earth-bound measurements indicate, and that the geoid has other irregularities deduced from spherical harmonic analysis.—DWR

00003 **Kinney, Douglas M.** Geologic mapping: Geotimes, v. 13, no. 1, p. 12–13, 1968.

Detailed and general purpose mapping in the United States, maps published at 1:250,000 and 1:1,000,000 at both Federal and State levels, and worldwide mapping smaller than 1:1,000,000 are reviewed.—ESL

Kirkwood, Samuel. *See* Swain, Frederick M. 04914

05037 **Kitahara, S.; Kennedy, George C.** The calculated equilibrium curves for some reactions in the system MgO-SiO_2-H_2O at pressures up to 30 kilobars: Am. Jour. Sci., v. 265, no. 3, p. 211–217, illus., tables, 1967.

Equilibrium curves have been calculated to 30 kilobars from thermodynamic data for the reactions: serpentine + brucite = 2 forsterite + 3 water, 5 serpentine = 6 forsterite + talc + 9 water, forsterite + talc = 5 enstatite + water, talc = 3 enstatite + quartz + water, brucite = periclase + water. The slopes of the curves became steep with increasing temperature and H_2O pressure. The unknown heats of reaction necessary for the calculations have been calculated from experimental equilibrium curves.—*from* Author's abstract

Kittleman, L. R. *See* Gray, Jane, 04939

05179 **Knopoff, Leon.** On convection in the upper mantle, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 341–346, 1967.

Estimates of viscosity and other pertinent parameters make it unlikely that thermal convection exists in the lower mantle. Criteria are suggested which evaluate the pertinence of the hypothesis to the upper mantle, and which are formally independent of viscosity. Estimates of these quantities can be obtained from the model in which Newtonian viscosity is used. It is postulated that since these quantities are independent of viscosity, their estimates will apply, to an order of magnitude, to other models of viscosity. The estimates of the time necessary to set up stable convection and of the gravity anomaly expected over a convecting mantle are consistent with the hypothesis of upper mantle convection. Estimates of depression of the geoid over a rising current and of the horizontal scale of the

convection cells are apparently inconsistent with upper mantle convection.—*from* Author's abstract

Ko, Kyung Chul. *See* Pifer, Drury A. 05377

05148 **Kovach, Robert L.** Surface waves and earth structure, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 407–409, 1967.

Progress in the study of surface waves made during 1963–67 is reviewed, with a bibliography of pertinent works. Broadly speaking, the interpretive tools for analyzing surface waves have been strengthened and used to study regional velocity variations in the upper mantle and the anelastic structure of the Earth.—DBV

05166 **Kovach, Robert L.** Attenuation of seismic body waves in the mantle, *in* Nonelastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 165–170, illus., 1967.

The attenuation of seismic body-waves is a direct measure of the absorption due to nonelastic processes within the Earth. Accurate amplitude decrement data for seismic body waves require the measurement of the spatial decay rate along a given ray, but measurements are restricted to the surface of the Earth. Recent studies have shown that the average Q, for shear, throughout the mantle is about 600 and that the average Q for the upper 600 km of the mantle is one order of magnitude less than the rest of the mantle. Spectral amplitude comparison of the seismic phases SKS and SKP with common paths in the mantle and core allows the Q, for compression, in the mantle to be estimated. Preliminary results indicate that the Q for compression is at least 2.5 times that for shear.—Author's summary

05306 **Kranck, E. H.** Anorthosite and rapakivi: Geologi, v. 19, no. 8, p. 93–94, 1967.

In gabbroic plutons of Bushveld, Stillwater and Duluth type anorthositic layers are associated with ultrabasic layers. The Precambrian anorthosites of Norway and Canada have more acidic associates grading from mangeritic quartz norite to quartz monzonite and often syenite. A mangeritic parental magma (Philpott, 1966), with a more felsic residual melt, agrees with age relations. Mangerite-anorthosite contacts are rarely seen, the gradational Sept Iles pluton in northern Quebec being an example representing multiple intrusions of hypabyssal type. Analyses of rapakivi and of mangeritic rocks from eastern Canadian anorthosite areas are strikingly similar. The rapakivi granites are associated with volcanites of the same composition; anorthosites associated regionally with rapakivi are subordinate in space compared with acidic rocks.—GDC

05322 **Kranck, E. H.** The Monteregian Hills: Geologi, v. 19, no. 8, p. 94–95, illus., 1967.

New discoveries and recent ideas on the origin of alkaline rocks have motivated a restudy of the classic Monteregian rocks from eight small stocks on an E–W axis between Montreal (Quebec) and the American border. Each hill has its own peculiar distribution, dominated by essexitic gabbro; trends of differentiation lead to oversaturated or undersaturated rocks. Extrusive rocks are not known, but diatreme breccias and breccia pipes are common. A ninth hill at Oka shows a ring complex around a core of carbonatite. Smaller alkaline bodies recently found, particularly northeast of the main hills, may give new information to explain the differentiation, shown in a simplified phase diagram.—GDC

05155 **Krause, Dale C.** Sea floor relief, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 631–638, 1967.

Seismic profiling has improved the interpretation of sea floor relief since 1963, giving precise details on sediment stratification and bedrock configuration. This review of progress since 1963 covers sea floor relief and its geologic interpretation and important advances in closely related fields. An extensive bibliography is given.—DBV

Kraut, Francois. *See* Fredriksson, Kurt. 05416

Kremp, G. O. W. *See* Traverse, A. 04960

04908 **Krumbein, W. C., Jr.** J. P. D. Hull (1889–1967) and the SEPM—A tribute: Jour. Paleontology, v. 41, no. 6, p. 1542–1543, portrait, 1967.

05232 **Kudo, Albert Masakiyo.** A study of the phase equilibrium of granitic melts [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1578B–1579B, 1967.

Kuroda, P. K. *See* Clark, R. S. 05421

05267 **LaChapelle, Edward R.** Glaciers, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 729–736, 1967.

United States research on glaciers since 1963 has included work on glacier variations and chronology at home and abroad, studies of deformation and flow of glaciers and ice sheets, and deep drilling. Arctic studies have been dominated by Greenland. In the Antarctic, oversnow traverses covered more than 5,000 km, with regularly spaced stations for seismic and gravity measurements, density and temperature determinations, and snow stratigraphy.—DBV

05294 **Ladanyi, B.; Don, Nguyen.** A cell test with rock [with French abs.], *in* On shear strength properties of natural soils and rocks—Geotech. Conf., Oslo, 1967, Proc.: Oslo, Norway, Norwegian Geotech. Inst., p. 283–288, illus., tables, 1967.

A limestone was submitted to cell tests, in which lateral restraint was realized by enclosing the specimens during axial loading in metallic cylinders of different rigidities. The loading path which could be followed was found to depend on the deformability of the specimen and the cylinder, as well as on the initial gap between them. The gap chosen was large enough that uniaxial failure of rock could occur, but sufficiently small to permit only a very limited deformation after failure. Under such conditions the rock after failure will continue to behave like a solid, retaining a great part of its original cohesive strength. It is concluded that residual strength of rock is not an intrinsic property, but is greatly influenced by the strain permitted to occur after failure.—*from* Author's summary

05233 **Lal, Ravindra Kumar.** The petrology of the cordierite–gedrite rocks and associated gneisses on Fishtail Lake, Harcourt Township, Ontario (Canada) [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1579B, 1967.

05203 **Lange, G. Robert; McKim, Harlan L.** Saturation, phase composition and freezing point depression in a rigid soil model: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 182, p. 1–12, illus., table, 1967.

Two series of experiments were performed. In the first, the calorimetric method of mixtures was used to explore effects of saturation and temperature in a porcelain block with very fine pore spaces. In the second series, freezing point depression determinations were also made at various levels of saturation in the same porcelain blocks. It is concluded that the phase composition of the water in frozen soils is also dependent on the degree of saturation as well as the temperature. It is suggested that rigid models are useful tools for investigating the freezing process in soils.—*from* Authors' abstract

Langway, C. C., Jr. *See* Oeschger, H. 04952

Larson, E. E. *See* Strangway, D. W. 05426

04912 **Laudon, Lowell R.** Ontogeny of the Mississippian crinoid *Platycrinites bozemanensis* (Miller and Gurley), 1897: Jour. Paleontology, v. 41, no. 6, p. 1492–1497, illus., 1967.

Twenty-eight specimens of *Platycrinites bozemanensis* (Miller and Gurley), 1897 have been chosen from among several hundred to depict the growth stages of this Mississippian species. Relations of height to width in cup plates were established

early and maintained throughout growth. Brachial plates in the lower arms reached their full height early and became wider with age. They were uniserial in the early growth stages, became cuneiform and finally biserial in the adult stage. The column was round in the early stages, remained round in the distal portion throughout growth and became progressively more elliptical and twisted with age. Plates of the tegmen became specialized last and are of most value in differentiating stage of evolution and characteristics of species.—Author's abstract

05009 **Laverdière, Camille.** Formations de cailloux plats posés sur la tranche en milieu littoral (lac Saint-Jean et estuaire du Saint-Laurent) [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 101, 1967.

05014 **Laverdière, Camille** Sur le lieu de fonte sur place de la calotte glaciaire de Schefferville [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 97, 1967.

05024 **Lavoie, Clermont.** Recherche des mines par le Turam [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 94, 1967.

05010 **Lavoie, Roger.** Trois plantes fossiles dans les dolomies de Dyer Bay, Ont. [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 94-95, 1967.

05029 **Leblanc, Gabriel.** L'emploi en seismologie des fonctions de transfert de la croute terrestre [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1956-66, v. 33, p. 91, 1967.

05357 **Leblanc, Gabriel; Howell, Benjamin F., Jr.** Spectral study of short-period *P*-waves: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1049-1063, illus., tables, 1967.

The variability of 37 short-period *P*-wave spectra was studied. Amplitude level is affected by distance and crustal effects. Similarity of the over-all shape of the spectra is attributed to the source. An oscillatory character is related to the crustal effect. Acting as a mask, the crustal effect prevents quantitative measurements of the attenuation and of the radiation pattern. By an averaging of spectra, the crustal masking can be partly overcome, and an approximation of the spectrum of the pulse incident at the mantle-crust boundary obtained. Selected average spectra suggest that over the frequency range 0.4 to 0.9 cps, very little, if any, differential attenuation takes place. The use of crustal filtering seems required.—*from* Authors' abstract

04989 **Lebourg, M.; Campbell, A. T., Jr.; Witterholt, E. J.** Detection of deep formation "damage", *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. Q1-Q22, illus., 1967.

A method is described whereby positive identification can be made between deep "damage" and low permeability. The method takes advantage of a deviation from the Horner assumption in his theory of superposition. Under drill stem test conditions where the flow rate is very low, an expanding dominant transient is created by the afterflow extending the radius of investigation during the shut-in period. An extended shut-in, in many cases, will allow an inspection of the permeability at a great distance from the well bore. Data received by the "Tele-Pressure" method can be utilized to take advantage of the new technique. Also, re-testing with originally-obtained data from the formation has been successfully used. Field tests and mathematical support are given.—*from* Authors' abstract

05026 **Ledoux, Robert.** Étude par spectroscopie infrarouge du lien hydrogène résultant de l'interaction des groupes CO et NH_2 avec les surfaces des phyllosilicates [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 89-90, 1967.

05160 **Leeuw, M. M. de.** New Canadian bathymetric chart of the western Arctic Ocean north of 72°: Deep-Sea Research, v. 14, no. 5, p. 489-504, illus., 1967.

Canada has accepted responsibility for the compilation of bathymetric plotting sheets for the western hemisphere, north of the seventy-second parallel. Four sheets covering this area have been completed. All retrievable data are collected, evaluated and selectively plotted on a polar stereographic projection at a scale of 1:2 M at

the pole. The resulting bathymetric interpretation presented in one fold-out chart is based on about 12,000 plotted depths in meters, corrected for the vertical variations in the velocity of sound. Contours are drawn with a 500 m interval beyond the 200 m isobath, which is also displayed. Newly suggested names for some features are introduced and a general description of the geomorphic provinces is presented.—*from* Author's abstract

Lehmbeck, William L. *See* Post, Edwin V. 05291

Leighty, R. G. *See* Yuan, T. L. 05323

Lemish, John. *See* Elwell, James H. 05082

Leonard, J. W. *See* Donahue, B. A. 05195

05035 **Leonardos, O. H., Jr.; Fyfe, W. S.** Serpentinites and associated albitites, Moccasin quadrangle, California: Am. Jour. Sci., v. 265, no. 7, p. 609–618, illus., table, 1967.

Albitites believed to be derived from volcanic rocks and sediments were extensively developed by contact metasomatism during serpentinization of ultrabasic rocks in the Mother Lode belt, California. Their mineralogy is consistent with metasomatic processes occurring at moderate temperatures and low pressures.—*from* Authors' abstract

04995 **Lespérance, Pierre-J.** Quelques trilobites de la formation du White Head de la région de Percé [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 94, 1967.

Lewis, Charles F. *See* Moore, Carleton B. 05378

Lidiak, Edward G. *See* Muehlberger, William R. 05302

05182 **Lieber, Paul; Braslau, David.** Relaxation phenomena and the origin of earthquakes, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 439–448, 1967.

A layered half-space is presented as a model for the crust-mantle system, both mediums having elastic and inelastic properties. The time sequence of shallow earthquakes is studied, with special consideration of the material properties of crust and mantle. The earthquake mechanism is modeled after the San Andreas Fault, and considered as a discrete Volterra type dislocation. A three-dimensional boundary value problem in static linear elasticity (material assumed to be incompressible) is solved. The solution reduces to the classical one obtained for the half space. Time dependent properties are introduced by means of Biot's correspondence principle of linear viscoelasticity. Solutions are obtained in quadrature for surface displacements and some stresses at the interface. Postglacial uplift and its relation to the inelastic properties of the system are described briefly.—DBV

05039 **Lilly, H. D.; Deutsch, E. R.** Paleomagnetic reconnaissance on the continental shelf, 170 kilometers east of Cape Race, Newfoundland: Am. Jour. Sci., v. 265, no. 3, p. 218–224, illus., table, 1967.

Paleomagnetic studies on the continental shelf can be useful in testing paleogeographic reconstructions on opposite sides of the Atlantic Ocean. Toward this end, bedrock has been oriented under water and recovered by divers at two shoals of the Virgin Rocks on the Grand Banks of Newfoundland. The rock is a sedimentary breccia, resembling lithologically the rocks of the lower Conception group of late Proterozoic age, which are exposed on the Avalon Peninsula. The technique requires refinement, and only three samples proved suitable for paleomagnetic measurement. However, the rocks show some magnetic stability, and the remanence vectors make large angles with the Earth's present field. While the magnetic results are inconclusive, pending a systematic study of the high shoals,

the reconnaissance has demonstrated that detailed paleomagnetic work on the continental shelf is feasible.—Authors' abstract

Lipschutz, Michael E. *See* Jaeger, Ralph R. 05401

Livingston, J. L. *See* Burchfiel, B. C. 04938

05172 **Logsdon, Truman; Brown, Alton R.** 'Hunton'—Hottest play in Oklahoma: Shale Shaker, v. 18, no. 4, p. 63–70, illus., 1967.

The entire Silurian–Devonian Hunton Group of the Anadarko basin shelf in northwest Oklahoma is considered as a carbonate unit, recognizing only broad facies changes. Increased basinward thickening suggests that the Anadarko basin was an embayment superimposed on a much larger shelf area; deposition of Hunton beds and succeeding formations is reviewed. Two cross sections, a Sylvan structure map, and a Hunton isopach map are given. More control may delineate more faults outlining a shear zone as another potential hinge line. The isopach map shows variable thicknesses due to the pre–Woodford unconformity; stream erosion on this surface shaped the oil traps present today. Determination of the wedge-edge and presence of the dolomite facies are especially important factors to be considered in exploring the Hunton for petroleum reservoirs.—ESL

Lovering, J. F. *See* Morgan, J. W. 05405

Luege, José R. *See* Egorov, S. V. 05001

04928 **Lund, Richard.** An analysis of the propulsive mechanisms of fishes, with reference to some fossil actinopterygians: Carnegie Mus. Annals, v. 39, art. 15, p. 195–218, illus., 1967.

A biological description of modern fish propulsion indicates that the axial skeleton is unnecessary for fish propulsion. The vertebral column would tend to limit flexibility of fish rather than increase it; therefore, lack of flexion must be an advantage. The hindmost caudal vertebrae only is flexible and contains all of the propulsive power. Chondrostean fish were heterocercal, and the tail was not used for propulsion. Holostean-level fish were hemi-heterocercal, and used the modified tail to amplify myomeric undulations for swimming. Jurassic pycnodonts had slight variations in this system. Amioid fish are similar, and the new Superfamily Caturoidei is erected; they have modern characteristics. Teleosts had developed this condition early and so took over the fish world.—HRC

00004 **Lyman, John.** Oceanography: Geotimes, v. 13, no. 1, p. 16–17, 1968.

Legislative action and organizational changes are reviewed as well as progress in the various scientific fields for 1967.—ESL

05122 **Lynch, J. J.; Durham, C. C.** Field laboratories for Operation Bathurst—A combined chemical and spectrographic analytical program, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 188–194, tables, 1967.

Operation Bathurst was a geochemical program carried out by the Geological Survey of Canada to discover the distribution of certain trace elements in stream and spring waters and sediments of the Bathurst–Jaquet River district of New Brunswick. Samples and measurements were taken at 1,500-ft intervals on the rivers and streams. Chemical analyses of the samples were done in a high school science laboratory in the area, and spectrographic analyses were performed in a mobile trailer. A description of the laboratories and some of the techniques employed is included.—MST

05304 **MacDonald, Harold C.; Brennan, Peter A.; Dellwig, Louis F.** Geologic evaluation by radar of NASA sedimentary test site: IEEE Trans. Geosci. Electronics, v. GE–5, no. 3, p. 72–78, illus., 1967.

Interdisciplinary research on the geoscience value of radar systems is being conducted at the Center for Research in Engineering Science, University of Kansas. This paper presents a segment of the research in which the investigators studied similarities and contrasts between panchromatic aerial photography and radar imagery from the Cane Springs area, Ariz., for which precise surface geologic data are available. Lithologic and structural information is available on the radar imagery which is not as apparent on the air photography; however, the converse is also true. Interpretations also reveal the fundamental advantage of multisensor reconnaissance, in which several discrete parts of the electromagnetic spectrum are utilized. The resulting extrapolation of data can provide a valuable supplement to geological reconnaissance.—*from* Authors' abstract

05312 **MacIntyre, Giles T.** Foramen pseudovale and quasi-mammals: Evolution, v. 21, no. 4, p. 834-841, illus., 1967.

The trigeminal foramen opens between the periotic and alisphenoid bones in all known therapsid reptiles, but perforates the alisphenoid bone (foramen ovale) in some Late Cretaceous and most Cenozoic mammals (Theria). The position of the opening (called foramen pseudovale) in young living monotremes is here shown to be the same as in the therapsids; in adult monotremes and in fossil morganucodonts, triconodonts, and multituberculates the bones of the braincase are fused, obscuring the relationship; skulls of symmetrodonts, haramyids, and docodonts are unknown. "Quasi-mammal" is proposed as an informal designation for the above near mammalian non-therian groups, of uncertain relationships but best studied as therapsid reptiles. A definition of the class Mammalia is proposed which excludes quasi-mammals.—VMJ

MacKenzie, G. D. *See* Gagnon, P. M. 05170

Mackenzie, W. S. *See* Thompson, R. N. 05061

00031 **MacQuown, William C., Jr.; Dobrovolny, Ernest.** Geologic map of the Lexington East quadrangle, Fayette and Bourbon Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-683, scale 1:24,000, section, text, 1968.

Barite was mined from several small veins in the Lexington East quadrangle in the early part of the century. Although workings are no longer evident, barite float and some additional veins containing barite and calcite with minor amounts of galena and traces of sphalerite and fluorite are exposed in roadcuts and excavations. Lexington and underlying Tyrone Limestone are being exploited in the adjacent Lexington West quadrangle up to a depth of 150 feet. Phosphate rock, from leaching of calcium carbonate during weathering, occurs in minor amounts in residual soil of the Tanglewood Limestone Member of the Lexington Limestone.—MCM

05115 **Macurda, Donald B., Jr.** A Permian blastoid from the Canadian Arctic: Jour. Paleontology, v. 41, no. 5, p. 1282-1284, illus., 1967.

A Lower Permian (Artinskian) blastoid (genus and species indeterminate) is recorded from the Assistance Formation on Melville Island in the Canadian Arctic Archipelago. This is the first Permian blastoid found in the Western Hemisphere.—Author's abstract

Main, A. R. *See* George, R. W. 05307

00028 **Malde, Harold E.** Surficial geologic map of the Norwalk South quadrangle, Fairfield County, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-718, scale 1:24,000, 1968.

05386 **Malinowsky, Harold Robert.** Science and engineering reference sources—A guide for students and librarians: Rochester, N. Y., Libraries Unlimited, Inc., 213 p., 1967.

The book is divided into two sections; the first, using the science-engineering literature, contains a short chapter on literature searching and a longer one on forms of literature. The second part, "Sources of information in science-engineering,"

contains over 400 references divided into nine chapters according to disciplines: general science, mathematics, physics, chemistry, astronomy, geology, biology, engineering, and medicine. Each discipline is defined, problems concerned with literature discussed, and the reference books for that subject listed by category; most titles are annotated. A bibliography of selected readings pertaining to reference problems is included.—ESL

05023 **Mamet, Bernard.** Zonation du Carbonifère Inférieur d'après les foraminifères [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 93, 1967.

Mammerickx, Jacqueline. *See* Menard, H. W. 05310

05356 **Manning, P. G.** The optical absorption spectra of some andradites and the identification of the $^6A_1 \rightarrow {}^4A_1{}^4E(G)$ transition in octahedrally bonded Fe^{3+}: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1039-1047, illus., table, 1967.

The spectra show a very sharp d-d band at 22,700 cm^{-1} (440 mμ) that has been assigned to electronic transitions to the first field-independent state [$^4A_1{}^4E(G)$] in octahedrally bonded Fe^{3+}. A strong broad d-d absorption at 19,000 cm^{-1} in melanite has been assigned to octahedrally bonded Ti^{3+}. The andradites also show broad bands at 12,500 cm^{-1}, 16,500 cm^{-1}, and 21,400 cm^{-1} that are part of the Fe^{3+} spectrum. The Fe^{3+} octahedra in andradite and pyralspite are different. There is no justification, therefore, in giving an almandine-pyrope (that contains Fe^{3+}) an andradite content on the basis of Fe^{3+} analyses.—*from* Author's abstract

05002 **Marcus, Allan H.** Formation of the planets by accretion of planetesimals—Some statistical problems: Icarus, v. 7, no. 3, p. 283-296, illus., 1967.

This paper considers the distribution of the relative sizes of the largest planetesimals from which a planet is accreted in the final stages of growth, and distribution of the change in rotational angular momentum of the final planet as a result of the accretion of smaller bodies. The distribution of the random change in rotational angular momentum of the planet as a result of the accretion of planetesimals with random masses, velocities, and directions is derived. Collision speeds for the present Solar System planets turn out to be surprisingly small; one concludes that most of the initial rotational angular momentum imparted by collisions has somehow been lost or dissipated.—JHF

04948 **Martin, Bruce D.; Emery, K. O.** Geology of Monterey Canyon, California: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2281-2304, illus., 1967.

Monterey Canyon, about 75 miles south of San Francisco, extends southwest from the shore to beyond the base of the continental slope; it has a V-shaped profile, a meandering plan, and two major tributaries—Carmel Canyon from the south and Soquel Canyon from the north. The canyons are probably fault controlled; Monterey Canyon separates upper Pliocene sediments on the north slope from Cretaceous granodiorite on the south, and Carmel Canyon the granodiorite on the east slope from pre-Cretaceous metamorphics on the west. Canyon sediments contain bathyal foraminifers which are stratigraphically 400 feet higher than shallow-water forms in Pliocene sediments in the lower Salinas Valley to the southeast, suggesting at least 1,000 feet of vertical movement on a northward extension of the Reliz fault which separates the two areas. Six paleogeologic maps illustrate the geologic history from late Early Miocene to present.—BHK

Martin, Paul S. *See* Mehringer, Peter J., Jr. 05044

05234 **Martin, Richard Harold.** The Recent delta of the Guadalupe River, Texas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1579B-1580B, 1967.

05284 **Martin, Rudolf.** Reply [to discussion by James Helwig, 1967, of "Paleogeomorphology and its application to exploration for oil and gas", 1966]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2469-2470, illus., 1967.

Paleogeomorphological evidence does not indicate a phreatic phase in the formation of caves of East Harmattan of southern Alberta, but it cannot be denied that such a phase once existed (See Helwig, ibid., p. 2468).—WCC

Martinez, S. J. *See* Helander, Donald P. 04891

Marvin, Richard F. *See* Doe, Bruce R. 05262

05400 **Marvin, Ursula B.; Einaudi, Marco T.** Black, magnetic spherules from Pleistocene and recent beach sands, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1871–1884, illus., table, 1967.

Magnetic spherules have been discovered in natural concentrates of ilmenite and other heavy minerals in beach sands of Pleistocene and recent age. Spherules range in size from 80 to 650 μ, and consist mainly of magnetite, hematite and wüstite. There are three distinct chemical types of spherules: Type I, approximately 70 percent Fe; 5, Ni, 0.3, Co; and 0.2 , Cr. Type II consists of 70 percent Fe (O is estimated at 30 percent) or of 70 percent Fe plus 0.5 percent Mn. Type III contains Fe-poor, glassy spherules rich in SiO_2, Al_2O_3 and minor elements. Type I occurs in a Pleistocene sand in Florida and in recent sand in Brazil, Type II in Pleistocene and recent sands of the Greenland ice cap and other environments, and Type III only in a modern beach and may be either volcanic or industrial.—*from* Authors' abstract

05362 **Mason, Brian; Maynes, A. D.** The composition of the Allegan, Bur-Gheluai, and Cynthiana meteorites: U.S. Natl. Mus. Proc., v. 124, no. 3624, 12 p., tables, 1967.

Allegan is a chondrite with numerous chondrules of a wide variety of types; principal minerals are olivine and pyroxene, and accessory minerals include chromite and merrillite. In one of the many stones that fell in the Bur-Gheluai shower, principal minerals are olivine, pyroxene, and nickel-iron, and accessory minerals include chromite and merrillite; it is highly chondritic with the chondrules having poorly defined boundaries. Cynthiana is a mass of chondrules of a wide variety, many dark-rimmed; principal minerals are olivine and pyroxene, and troilite and nickel-iron are found in minor amounts. Chemical analyses are given for major and trace elements in all three. The first two are olivine-bronzite chondrites, and the third is an olivine-hypersthene chondrite.—ESL

05334 **Masuda, Akimasa.** An estimation of lanthanide partition coefficient for the 'calcium effect': Earth and Planetary Sci. Letters, v. 2, no. 4, p. 277–279, illus., tables, 1967.

Based upon the accomodation by host ion or host site and the assumed limitation effect by the oxygen anion, the partition coefficients of the lanthanides for crystallization under a 'calcium effect' were estimated.—Author's abstract

05430 **Mather, Kirtley F.** (editor). Source book in geology 1900–1950: Cambridge, Mass., Harvard Univ. Press, 435 p., illus., tables, 1967.

This is a sequel to the Mather and Mason source book published in 1939 and reprinted in 1964, which contained selections originating prior to 1900. Fifty-eight excerpts are presented in chronological order of the dates of birth of their authors. Writings in which new concepts or techniques were presented, or new directions opened for research, and articles describing the status of theory and practice were selected. Preference was given to the least accessible publications; eight are translated into English for the first time. A guide to subject matter is provided as well as an author index.—ESL

05113 **Mathers, Lewis John.** Flume study of boulder-strewn streams under flood discharge conditions using geometric roughness elements in transverse rows [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 3, p. 894B, 1967.

04946 **Matsushima, Shogo; Kennedy, George C.; Akella, Jagannadham; Haygarth, John.** A study of equilibrium relations in the systems Al_2O_3–SiO_2–H_2O and Al_2O_3–H_2O: Am. Jour. Sci., v. 265, no. 1, p. 28–44, illus., tables, 1967.

The above systems have been reexamined under hydrostatic conditions in piston-cylinder apparatus. The equilibrium boundary and the synthesis boundary of the reaction diaspore = corundum + water have been determined. The equilibrium boundary of the reaction kyanite = sillimanite has been determined and found to lie at sharply lower pressures than indicated by prior determinations of the synthesis field of sillimanite. The upper limits of the stability field of prophyllite both in equilibrium with corundum and equilibrium with quartz have been approximately determined.—*from* Authors' abstract

05088 **Matthews, Barry.** Late Quaternary land emergence in northern Ungava, Quebec [with French and Russian abs.]: Arctic, v. 20, no. 3, p. 176–202, illus., tables, 1967.

Twenty-one C-14 dates of [mainly mollusk] material from Late Quaternary marine terraces are used to construct an isostatic uplift curve. The phase of rapid uplift [7,000 to 6,000 yr B.P.] averaged about 26 feet per 100 years; for the past 5,200 years uplift was just under 1 ft per 100 years. Updoming resulted in an upward (southerly) tilt of "Glacier Beach" (460-ft strandline) and "Upper Tunit Beach" (100-ft strandline) at about 5.6 and 3.6 feet per mile. C-14 dates indicate general deglaciation of northern Ungava about 7,000 to 8,000 years ago. Twelve well formed marine terraces have been identified at the heads of major fjords. Fauna of "Upper and Lower *Aporrhais* Beaches" (40-ft and 55-ft strandlines) suggests optimal marine conditions from about 5,230 to 3,900 radiocarbon years ago during a possible marine transgression.—*from* Author's abstract

Maxwell, J. A. *See* Folinsbee, R. E. 05413

Maynes, A. D. *See* Mason, Brian. 05362

05212 **Mayr, Ernst.** Evolutionary challenges to the mathematical interpretation of evolution, *in* Mathematical challenges to the Neo-Darwinian interpretation of evolution—Symposium, Wistar Inst. Anatomy and Biology, 1966: Philadelphia, Pa., Wistar Inst. Press (Wistar Inst. Symposium Mon. 5), p. 47–54, discussions, p. 54–58, 1967.

Examples of differing rates of evolution are cited from the paleontological record to warn the mathematicians that parameters for rates and other factors, largely biological, are not easily adaptable to analysis. For instance, examples of extremely fast modern-day evolution are cited and also the slow rates exhibited by certain algae found in Precambrian rocks which appear to be identical to some living today. Further, the separation of the Atlantic fauna from the Pacific occurred when the Isthmus of Panama was closed nearly 5 million years ago, yet the changes which have since accrued are apparently nonexistent. Also, evolution appears to be rapid until the newly-found niche is filled, after which maintenance evolution alone is predominant. Paleontological examples are cited.—HRC

05333 **McBirney, Alexander R.; Gass, Ian G.** Relations of oceanic volcanic rocks to mid-oceanic rises and heat flow: Earth and Planetary Sci. Letters, v. 2, no. 4, p. 265–276, illus., tables, 1967.

The degree of silica saturation of basalts and differentiated rocks of oceanic islands can be correlated with the position of an island on the crest or flanks of oceanic rises. In both the Atlantic and Pacific, strongly oversaturated rocks are found on or near the crests of the East Pacific Rise and Mid-Atlantic Ridge, whereas undersaturated alkaline rocks appear on the flanks and in areas far removed from rises. A close relation to heat flow from the ocean floor suggests that the more siliceous rocks near the crests are produced by melting at shallow depths while more alkaline magmas erupted far down the flanks are produced at greater depths. The relations have possible implications bearing on hypotheses of sea floor spreading and the origin of oceanic rises.—*from* Authors' abstract

05269 **McCarthy, Eugene D.; Calvin, Melvin.** Organic geochemical studies—[Pt.] 1, Molecular criteria for hydrocarbon genesis: Nature, v. 216, no. 5116, p. 642–647, illus., 1967.

The biogenic synthesis of isoprenoid structure and the nonbiogenic synthesis of polyisoprenoid structure, nonbiogenic polymerization processes and chemical evolution, and criteria for biogenic origin are discussed. The problem of the origin of the isoprenoid hydrocarbons in rocks remains inconclusive. Evidence still indicates that isoprenoid hydrocarbons are in most cases derived from biological sources, even in Precambrian samples. It is in that geologic time period, however, that the transition between chemical evolution and the advent of biological systems is being sought. The possibility of nonbiogenic isoprenoid hydrocarbons is a very real one, and criteria must be established to distinguish between those of abiogenic and biogenic origin.—DBV

05133 **McGinnis, Helen J.** The osteology of *Phlegethontia*, a Carboniferous and Permian aïstopod amphibian: California Univ. Pubs. Geol. Sci., v. 71, 49 p., illus., tables, 1967.

Phlegethontia is one of the two genera of Aïstopoda, an order of Paleozoic snakelike lepospondyl amphibians. New material from the Pennsylvanian of Linton, Ohio, and Mazon Creek, Ill., is described; discovery of a braincase and vertebrae from Fort Sill, Okla., extends the range into early Permian. Except for a broad-ribbed individual from Ohio, the North American specimens do not seem specifically different from the Czechoslovakian *P. longissima*. The skull is highly specialized. In comparison with contemporary lepospondyls, the genus is possibly closest in skull structure to primitive Nectridea, as *Sauropleura*, and farthest from the Microsauria. It is probably not ancestral to any recent amphibians.—VMJ

05321 **McGrain, Preston.** The geologic story of Bernheim Forest: Kentucky Geol. Survey, ser. 10, Spec. Pub. 13, 26 p., illus., 1967.

Bernheim Forest, a privately endowed woodland and natural science educational area, is in north-central Kentucky where the Blue Grass region, underlain by Ordovician limestones of the Cincinnati arch, is bordered by the Knobs, a belt of ridges and isolated hills representing an east-facing escarpment capped by resistant Mississippian limestones. This booklet is designed to provide general geological background material for the visitor to the Forest; more detailed information may be found in the references cited. Geologic history of the area is summarized and some of the sedimentary rock types are briefly described. In the section on topography, dissection of the upland by streams and formation of the conical knobs are discussed.—VMJ

McKim, Harlan L. *See* Lange, G. Robert. 05203

05235 **McKniff, Joseph Michael.** Geology of the Highlands-Cashiers area, North Carolina, South Carolina, and Georgia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1580B, 1967.

McKown, D. *See* Schmitt, R. A. 05410

McMahon, B. E. *See* Strangway, D. W. 05426

05352 **McTaggart, K. C.; Thompson, R. M.** Geology of part of the northern Cascades in southern British Columbia: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1199–1228, illus., tables, geol. map, 1967.

The late Paleozoic(?) Hozameen Group, composed of chert, greenstones, limestone, and argillite, at least 20,000 feet thick, was metamorphosed in late Paleozoic or Triassic time to form the Custer Gneiss. In Late Cretaceous time was the emplacement of the Spuzzum and Yale Intrusions, the deposition of Eocene conglomerate and sandstone, and finally the intrusion of the Chilliwack batholithic rocks which are partly of Miocene age. Several periods of deformation produced fold axes trending northwest, northeast, and northerly. There are three main fault zones. One separates the Custer Gneiss from its overlying cover of Hozameen rocks.

A second separates the Hozameen beds from Mesozoic formations to the east. The third is represented by the Hope and Yale faults.—*from* Author's abstract

05296 **Meade, Grayson E.** Memorial to Russell Warren Burns (1912–1967): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 11, p. 2312–2313, portrait, 1967.

04988 **Meese, A. D.; Walther, H. C.** An investigation of sonic velocities in vugular carbonates, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. P1–P7, illus., table, 1967.

When conventional sonic log analyses are applied to vugular carbonates, the calculated porosities are often greatly in error. To study this problem, the traveltime of vugular cores were measured for samples from four wells. This laboratory data shows a linear relation between porosity and traveltime, but the so called fluid velocity term is larger than that normally used. Thus conventional analysis yields too low a porosity. As an alternative, an exponential equation is presented which uses a reasonable fluid velocity.—Authors' abstract

05044 **Mehringer, Peter J., Jr.; Martin, Paul S.; Haynes, C. Vance, Jr.** Murray Springs, a mid-postglacial pollen record from southern Arizona: Am. Jour. Sci., v. 265, no. 9, p. 786–797, illus., tables, 1967.

A recount of pollen in the Murray Springs deposit has verified Martin's (1963) contention that at least the younger part of the Altithermal interval in this area was relatively wet, not dry as it is usually considered. There are slightly greater relative numbers of pollen grains of mesic, and hydric species, especially pine, sedge, and cattail, in beds deposited 4,000 to 5,000 years ago as indicated by radiocarbon dates. Present vegetation zones were displaced downward about 300 meters, and grassland and woodland communities expanded areally in the upper San Pedro Valley.—RWT

05310 **Menard, H. W.; Mammerickx, Jacqueline.** Abyssal hills, magnetic anomalies and the East Pacific Rise: Earth and Planetary Sci. Letters, v. 2, no. 5, p. 465–472, illus., 1967.

Long ridges and troughs are characteristic of the East Pacific Rise off North and Central America. The trends of the topography are parallel to the trends of magnetic anomalies but are not specifically related. Locally the topography, like the magnetic anomalies, shows a gross symmetry and the sea floor spreading hypothesis could account for that fact. Simultaneous rifting and accumulation of lava flows around opening rifts appear capable of generating this topography.—Authors' abstract

05370 **Meneley, W. A.** Geology and groundwater resources of the Melfort area (73-A), Saskatchewan: Saskatchewan Research Council Geology Div. Map 6, scale 1:250,000, sections, text, 1967.

The degree of mineralization of water in the Melfort area does not increase with depth. Ground water found in highly permeable, extensive aquifers is typically less mineralized than that found in low permeability aquifers, regardless of depth. The Cretaceous Blairmore Formation is a potential aquifer for small and intermediate supplies in the northwest, but total dissolved solids increase rapidly toward the south and west; the Oldman Formation may be a potential aquifer for small supplies in the southwest. The principal and greatest potential source of ground water is in the sand and gravel aquifers, drift thickness ranging from less than 100 to more than 980 feet.—MCM

00010 **Menzel, Muriel; Pratt, Marilyn.** Pint's Quarry minerals: Gems and Minerals, no. 364, p. 24–28, illus., 1968.

In Pint's quarry, a mecca for mineral collectors, near Raymond, Iowa, three members of the Devonian Cedar Valley Formation, dolomitic limestones, are exposed. Calcite in varied forms and colors occurs in pockets, cavities, and vugs; drusy quartz, chalcedony, and chert are found also. Both quartz and calcite crystals are often twinned or doubly terminated. Other minerals described and illustrated

are marcasite, pyrite, fluorite, barite, sphalerite, and galena. On the lowest level, coral reefs have been replaced with crystallized calcite.—ESL

05273 **Mercer, J. H.** Glacial resurgence at the Atlantic/sub-Boreal transition: Royal Meteorol. Soc. Quart. Jour., v. 93, no. 398, p. 528–534, table, 1967.

Some mountain glaciers in both the Northern and Southern Hemispheres advanced in late Atlantic and early sub-Boreal time, between about 5,200 and 4,600 radiocarbon years ago, and several in the Southern Hemisphere reached their greatest post-glacial extents. This suggests that the cool phase was as severe as at the start of the sub-Atlantic (ca. 2,800 radiocarbon years ago), but many botanists believe that the fluctuation was weak. Much botanical evidence indicates that the cool phase was followed by renewed warmth and divided the Hypsithermal Interval into two parts of unequal length.—Author's abstract

Merriam, D. F. *See* Cole, A. J. 05411

05085 **Meyer, Joachim D.** Geology of the Ahuachapán area, western El Salvador, Central America: Tulane Studies Geology, v. 5, no. 4, p. 195–215, illus., geol. map, 1967.

The Ahuachapán area, in western El Salvador between the town of Ahuachapán and the Guatemalan border, lies within an E–W trending graben which transgresses the entire republic and is believed to have formed from collapse of a geanticline at the end of the Pliocene. Quaternary volcanism along the margins and within the graben largely filled it with volcanic debris. The sequence in the area is: ancient agglomerate, laminar andesite, massive andesite, blue ignimbrite, gray agglomerate, lower brown tuff, pink ignimbrite, gray ignimbrite, pumice and upper brown tuff; total thickness is a maximum of 425 m. Strata are disrupted by a number of northeast-trending normal faults. Volcanic activity is still in progress at various centers in the region.—*from* Author's abstract

04987 **Miesch, E. P.; Albright, J. C.** A study of invasion diameter, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. O1–O14, illus., table, 1967.

This paper presents empirical correlations for the diameter of filtrate invasion, "DI", and for the true formation resistivity, RT, as a function of mud properties, exposure times, and formation properties. "DI" and RT values were calculated using Dual Induction Laterolog-8 logs through 676 zones from 26 wells. These values were independently correlated with normally-obtained drilling and logging parameters. Equations were obtained to predict "DI" with an average absolute deviation of 41.8 percent which in turn yielded an average absolute deviation of 13.1 percent for RT when good values were available for RXO and RILD, the deep induction log readings. The correlations are readily adaptable to computer logging programs.—*from* Authors' abstract

05168 **Milici, Robert C.** The physiography of Sequatchie Valley and adjacent portions of the Cumberland Plateau, Tennessee: Southeastern Geology, v. 8, no. 4, p. 179–193, illus., table, 1967.

The Tennessee River eroded headward and cut through the Sequatchie ridge of Pennsylvanian clastics in Mesozoic time, initiating the Sequatchie Valley which was extended by headward erosion, solution of limestones, and assimilation of uvalas. During Tertiary, the river developed a wandering course above the level of the central Knox ridge, and in late Tertiary and Pleistocene it was incised at least 400 feet. Some of the winding pattern was preserved, and several larger tributaries were able to maintain their courses across the ridge. Pauses in downcutting are marked by two levels of alluvial terraces, and remnants of a third; two interfinger with boulders of Pleistocene alluvial fans. The landscape is in dynamic equilibrium, and has undergone downwasting continuously since the end of the Paleozoic.—*from* Author's summary

05220 **Miller, R. D.** Discussion—App. A *in* Saturation, phase composition and freezing point depression in a rigid soil model, by G. R. Lange and H. L. McKim: U.S.

Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 182, p. 13, 1967.

Miller indicates that the paper reminds us that we cannot say much about the freezing of water in partially saturated soils. He points out that the authors should have used the interfacial energy of an ice–water phase boundary instead of that for air–water, and that the residual unfrozen water content should have been plotted instead of the initial water content.—ESL

04944 **Minch, John A.** Stratigraphy and structure of the Tijuana–Rosarito Beach area, northwestern Baja California, Mexico: Geol. Soc. America Bull., v. 78, no. 9, p. 1155–1177, illus., geol. map, 1967.

Interlayered basalt flows, pyroclastic rocks, and clastic sedimentary rocks form a 1,200-ft thick section along the coastal area near Tijuana in northwestern Baja California. The name Rosarito Beach Formation is proposed for this rock sequence, which is further subdivided into five members. A Miocene to Pliocene age is assigned to the entire succession. Detritus of the Franciscan type indicates a western source for part of the section, and flow structures in the basalts suggest an origin in the same direction. High-angle north–south faults and gently westward-dipping strata dominate the structure of the area.—JGV

05103 **Mogensen, J.** The analysis of large numbers of geochemical samples [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 272, 1967.

Mohler, Hans P. *See* Hay, William W. 04907

Moorbath, S. *See* Fairbairn, H. W. 05331

05437 **Moore, B. J.; Shrewsbury, R. D.** Analyses of natural gases, 1966: U.S. Bur. Mines Inf. Circ. 8356, 130 p., tables, 1967.

Analyses for helium and other components are reported for 374 samples of natural gas collected in 1966 as part of a continuing survey of helium resources of the free world. Samples include 341 from gas and oil wells in 24 states, 18 from wells in 4 other countries, 10 from pipelines in 4 states, and 5 from foreign pipelines.—ERL

05378 **Moore, Carleton B.; Birrell, Pamela Jost; Lewis, Charles F.** Variations in the chemical and mineralogical composition of rim and plains specimens of the Cañon Diablo meteorite, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1885–1892, tables, 1967.

Quantitative chemical and modal mineralogical analyses were made on samples representing "rim" and "plains" populations of the Cañon Diablo meteorite. These investigations indicated that the volume percent of the taenite plus plessite phase, the volume percent of oxide phase, the total weight percent nickel and the density are different to a level of significance of 0.05 for each of the populations. Other phases and chemical constituents determined showed no significant differences. The values obtained for the components showing differences were: taenite plus plessite, "rim" 3.98 and "plains" 1.53 vol. percent; oxide, "rim" <0.01 and "plains" 3.04 vol. percent; nickel, "rim" 7.40 and "plains" 7.10 wt. percent; and density, "rim" 7.85 and "plains" 7.81. Diamonds were found only in "rim" samples.—Authors' abstract

Moore, Carleton B. *See* Buseck, Peter R. 05423

Moore, E. J. *See* Desai, K. P. 04986

Moore, W. J. *See* Stacey, J. S. 05311

05405 **Morgan, J. W.; Lovering, J. F.** Rhenium and osmium abundances in chondritic meteorites, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1893–1909, illus., tables, 1967.

The abundances of Re and Os in 32 chondrites representing all classes have been determined by neutron activation analysis. Some disagreement with previous determinations of Os in ordinary chondrites can be explained by the difficulties of sampling for siderophilic elements when metallic nickel-iron is present. Considerable fractionation of Re and Os between chondrite classes is apparent, and cannot be interpreted solely on the basis of transfer of metallic phase rich in these two elements. Solar atomic abundances relative to 10^6 atoms Si calculated from the mean of all chondrites analyzed are 0.053 atoms Re and 0.61 atoms Os. Authors' abstract

05104 **Morris, H. C.** Four geochemical exploration case-histories from eastern Canada [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 273-274, 1967.

05289 **Morris, M. T.** Memorial to John Melvin Law (1914-1967): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2478, portrait, 1967.

04982 **Morris, R. L.; Biggs, W. P.** Using log-derived values of water saturation and porosity, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. X1-X26, illus., tables, 1967.

For intervals indicated to be above the transition zone, the computed values of porosity and water saturation can be used in an empirical method to determine the permeability of the interval. Augmented by knowledge of formation pressure, fluid viscosities, and volume factors, these data provide a reasonable estimate of initial rate of production from the untreated intervals. Additional empirical methods are used for the estimations of relative permeabilities to oil and water for intervals in the transition zone. They provide reasonably accurate estimations of the water fraction of production. The methods are useful in carbonate and sand formations, both clean and shaly; they extend the utility of the log data; they signal unusual formation properties, and provide a check on the efficiency of the completion.—*from* Authors' abstract

05246 **Morrison, Huntly Frank.** A magnetotelluric profile across the State of California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1588B, 1967.

05236 **Morrison, Roger Barron.** Soil stratigraphy—Principles, applications to differentiation and correlation of Quaternary deposits and landforms, and applications to soil science [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1580B-1581B, 1967.

05339 **Moyle, W. R., Jr.** Water wells and springs in Soda, Silver, and Cronise Valleys, San Bernardino County, California: California Dept. Water Resources Bull. 91-13, [61] p., illus., tables, geol. map, 1967.

The valleys described in this report cover about 1,300 sq mi. The area is characterized by broad alluvial fans and plains; these unconsolidated deposits contain most of the ground water, received as runoff from the hills and mountains and during floods of the Mojave River. The consolidated rocks consist of the basement complex, Tertiary volcanic and sedimentary rocks, and Quaternary basalt. Appended data consist of descriptions of wells and springs, water-level records, drillers' logs, chemical analyses, and pumping tests. A reconnaissance geologic map showing well locations is included.—ESL

05340 **Moyle, W. R., Jr.** Water wells and springs in Bristol, Broadwell, Cadiz, Danby, and Lavic Valleys and vicinity, San Bernardino and Riverside Counties, California: California Dept. Water Resources Bull. 91-14, [63] p., illus., tables, 1967.

The data presented were collected by the U.S. Geological Survey as a phase of the cooperative investigation of water wells and general hydrologic conditions in the desert region of southern California. The valleys described have an area of about 2,600 sq mi; the area is one of interior drainage with no perennial streams. Broad alluvial fans extend into the basin from the mountains, and alluvium contains most of the ground water, received as runoff from the hills and mountains. Consolidated rocks consist of the basement complex, Tertiary volcanic and

sedimentary rocks, and Quaternary basalt. The lower parts of the valleys are occupied by playa lakes, usually dry. Some wells produce commercial brines. Descriptions of wells and springs, water level records, chemical analyses, drillers' logs, a cross index of published logs, and four reconnaissance geologic maps with well locations are included.—ESL

05302 **Muehlberger, William R.; Denison, Rodger E.; Lidiak, Edward G.** Basement rocks in continental interior of United States: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2351–2380, illus., 1967.

Buried basement rocks from more than 3,000 wells and outcrops in the continental interior were studied petrographically. The Precambrian geologic history is outlined chronologically by describing several selected areas from north to south. Lateral continental accretion is of lesser importance than is usually postulated; at least 50 percent of North America was in existence 2,500 m.y. ago. Crustal stabilization occurred at different times (about 2,500, 1,700, 1,350, and 1,000 m.y. ago).—WCC

05330 **Munk, Miner N.** Spallation neon, argon, krypton, and xenon in an iron meteorite: Earth and Planetary Sci. Letters, v. 2, no. 4, p. 301–309, illus., tables, 1967.

Abundance of the 21 stable isotopes of neon, argon, krypton, and xenon were measured in the Costilla Peak iron meteorite. A pronounced spallation component was observed in all four; neon and argon results agreed with previous measurements. Integration of a recent Rudstam formula over the Arnold, Honda, and Lal cosmic ray spectra accurately predicts isotopic composition of observed spallation component in all cases except, possibly, neon. Calculated production rates for Ne–21 and Ar–38 give cosmic-ray exposure ages of 560 m.y. and 500 m.y., respectively, for a sample depth of 100 g/cm^2. Large variations in exposure ages based on krypton and xenon may be explained by lack of knowledge about target element abundances. Small and questionable amounts of Xe–129 in addition to trapped and spallation components indicate a longer I–129—Xe–129 formation interval for Costilla Peak than for chondrites.—*from* Author's abstract

04915 **Murphy, James L.; Stevens, R. P.** Pelecypod species from the Brush Creek Shale Member (Conemaugh) of Ohio: Jour. Paleontology, v. 41, no. 6, p. 1498–1504, illus., 1967.

Four Pennsylvanian pelecypod species originally described by R. P. Stevens from the Brush Creek Shale Member (Conemaugh) at Summit Cut, Columbiana County, Ohio, are reconsidered. *Leda bellistriata, Avicula triplistriata,* and *Posidonomya striata* are retained and assigned to *Polidevcia, Lima,* and *Dunbarella* respectively. *Avicula orbiculus* is considered a *nomen negatum* and to be synonymous with *Streblopteria oklahomensis* Newell. *Dunbarella whitei* (Meek) and *D. appalachiensis* Lintz are placed in synonymy with *D. striata* (Stevens). *Lima krotowi* Mark and *Limatula? fasciculata* Girty are placed in synonymy with *Lima triplistriata* (Stevens).—*from* Authors' abstract

05114 **Murray, Grover E.; Weidie, A. D., Jr.** Regional geologic summary of Yucatán Peninsula, *in* Yucatán field trip guide book (2d edition)—Geol. Soc. America, 1967 Ann. Mtg., Field Trip 7: New Orleans, La., New Orleans Geol. Soc., p. 5–51, illus., reprinted 1967; originally published 1962.

Murthy, G. S. *See* Deutsch, E. R. 05343

00009 **Myers, John C.** Sulphur—Its occurrence, production and economics: South Texas Geol. Soc. Bull., v. 8, no. 1, p. 2–15, illus., tables, 1968.

The history of sulfur production is reviewed. Occurrence is discussed under: elemental sulfur, from the caprock of salt domes along the Gulf Coast of the United States and Mexico, and sedimentary deposits located in many places; recovered sulfur from sour oil and gas, and from sulfur compounds, pyrite, marcasite, and pyrrhotite ores, by heating or from smelter gas. The economics are reviewed, including, as sources of supply, sour gas fields in Texas, Alberta, and France; and the Athabasca tar sands.—ESL

05309 **Nairn, A. E. M.** Neuere Untersuchungsmethoden der Geophysik und das Problem der Bewegung der Kontinente [with German, English, French and Russian abs.]: Geol. Runcschau, v. 56, no. 3, p. 927–948, illus., 1967.

The basic paleomagnetic argument for large scale continental displacement reviewed here is accepted as valid, and the data available indicating current movements of the same order of magnitude briefly discussed. Two interpretations, static and dynamic, of the gravity, heat flow, and seismic data which indicate the departure of the Earth from a hydrostatic state are described. Adopting the dynamic interpretation, the convection hypothesis explains continental drift, and can also be used to interpret modern oceanographic results. Among geological implications of convection as the drift mechanism, reference is made to a possible "cycling" of oceanic crust, and to the possible relation of anomalous paleomagnetic results to questions of megatectonics in orogenic areas.—*from* Author's abstract

05237 **Nash, John Thomas.** Geology and uranium deposits of the Jackpile mine area, Laguna, New Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1581B, 1967.

Needham, H. David. *See* Schneider, Eric D. 05425

04935 **New England Intercoll. Geol. Conf.; Robinson, Peter; Drake, David P.** (editors). Guidebook for field trips in the Connecticut Valley of Massachusetts—59th Ann. Mtg., honoring Benjamin Kendall Emerson (1843–1932), Amherst, Mass., Oct. 1967: [New Haven, Conn., Yale Univ., Dept. Geology] 194 p., illus., tables, geol. maps, 1967.

This guidebook includes 14 items that are cited separately: Introduction, Massachusetts bibliography of B. K. Emerson, and 12 field trips (Trips A through M), by P. Robinson, M. Cassidy, N. L. Hatch, Jr., R. S. Stanley, G. P. Brophy, J. B. Hartshorn, O. C. Farquhar, J. D. Peper, N. J. Trask, Jr., J. O. Guthrie, J. M. Wessel, R. H. Jahns, and others.—VMJ

05404 **Nichiporuk, Walter; Chodos, Arthur; Helin, Eleanor; Brown, Harrison.** Determination of iron, nickel, cobalt, calcium, chromium and manganese in stony meteorites by X-ray fluorescence, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1911–1930, illus., tables, 1967.

The concentrations of total iron, Ni, Co, Ca, Cr and Mn have been determined by X-ray fluorescence in 57 chondrites, 7 carbonaceous chondrites, 3 enstatite chondrites, 15 achondrites and in the silicate phase of 2 pallasites. The high-iron-group chondrites have an average of 27.36 percent Fe by wt., and the low-iron group an average of 21.71 percent Fe by wt. Their Ni and Co contents show comparable differences. Significant differences in concentrations of Ca and Mn are found between chondrites and those of the low- and high-iron groups. The ratios Ca:Mn are quite constant between the groups. The ratios Fe:Ca and Ca:Mn for the carbonaceous chondrites of Type II and Type III differ generally from the Fe:Ca and Ca:Mn ratios for high-iron chondrites. Ca-poor achondrites are much more variable in composition than the Ca-rich.—*from* Authors' abstract

05089 **Nichol, Ian; Garrett, R. G.; Webb, J. S.** Automatic data plotting and mathematical and statistical interpretation of geochemical data, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 195–210, illus., 1967.

This paper introduces methods of automatic plotting and objective interpretation of geochemical data using computer techniques and automatic plotting by a Stromberg-Carlson 4020. In areas of simple geochemistry, trend surface analysis makes possible the representation of major regional trends with minor features superimposed upon these trends as residuals. Due to limitations of trend surface techniques, rolling means were investigated as an alternative of assessing regional trends in data. In areas of complex geology, the use of factor-vector analyses has been demonstrated as a means of identifying and quantifying the various causal factors contributing to a set of data.—MST

05175 **Nichols, Harvey.** The disturbance of arctic lake sediments by "bottom ice"—A hazard for palynology: Arctic, v. 20, no. 3, p. 213–214, illus., 1967.

During warm weather in July 1966, bottom ice in a small shallow lake north of Pelly Lake, Northwest Territories, Mackenzie, was observed floating to the surface in massive blocks at least 1 m thick. This ice seemed to contain a large portion of the lake sediments, which fell to the bottom in random order as the ice melted; wind blew the ice blocks around the lake and some rolled over, reversing the sedimentary sequence. The "mud-centre" tundra lakes in Manitoba observed by Bryson and Ragotzkie (1964) may have showed the same phenomenon. It seems reasonable to suggest that sediments of shallow lakes, or shallow peripheries of deep lakes, in arctic or subarctic regions should not be used for stratigraphic purposes such as pollen analysis. Stratigraphic disturbance may also be expected in Pleistocene glacial-lake deposits.—VMJ

Nichols, Robert L. *See* Bendix-Almgreen, Svend E. 05213

04932 **Nicol, David.** Some characteristics of cold-water marine pelecypods: Jour. Paleontology, v. 41, no. 6, p. 1330–1340, tables, 1967.

All cold-water pelecypods have certain shell characteristics in common, including: thin and commonly chalky shells; general lack of bright colors on the shells and absence of color patterns; absence of spines; ornamentation, where present, subdued; shells generally of small size; and growth rings that are indicative of slow growth. The shallow-water Arctic pelecypod fauna, although superficially resembling the shallow-water Antarctic pelecypod fauna, differs from it greatly. No species is common to both polar regions, and only 28 percent of the genera and 43 percent of the families are common to the two regions. Both polar areas have an impoverished pelecypod fauna with respect to the number of species, genera, and families.—*from* Author's abstract

04929 **Nitecki, Matthew H.** Bibliographic index of North American archaeocyathids: Fieldiana—Geology, v. 17, no. 2, p. 105–220, illus., table, 1967.

This bibliographic index includes systematic and stratigraphic entries on the species of North American archaeocyathids. Each entry consists of name, reference, stratigraphic [all Lower Cambrian] and geographic location, and number and depository of cited specimens. Seventy-five species are recognized and distributed in twenty-six genera. Short sections on the definition, history [of research], affinities and classification of archaeocyathids are included.—Author's abstract

05207 **Niven, David W.; Gries, John Paul.** Determination of porosity and permeability of selected sandstone aquifers of South Dakota [abs.]: South Dakota Acad. Sci. Proc. 1967, v. 46, p. 244–245, 1967.

Niven, David W. *See* Gries, John Paul 05209

05270 **Noble, D. C.; Billings, M. P.** Pyroclastic rocks of the White Mountain magma series, New Hampshire: Nature, v. 216, no. 5118, p. 905–906, 1967.

Recent field examination of outcrops of the Moat Mountain block of the White Mountains, supplemented by thin-section examination of representative specimens, reveals that the phenocrysts are highly fractured. Indistinct but unquestionable eutaxitic structure was also observed at a number of localities. The thick (10,000 feet) sequence of silicic Moat volcanics is layered in a manner more suggestive of a pyroclastic sequence, particularly of ash-flow cooling units, than of a pile of lavas. Lithic fragments also suggest a pyroclastic origin. The association of the Moat volcanics with ring dikes is consistent with the interpretation as the lower-level manifestation of the main vent area of a collapse caldera type, suggested for similar structural associations elsewhere and undoubtedly applicable here.—DBV

05382 **Northwood, E. J.; Weisinger, R. C.; Bradley, J. J.** Recommended standards for digital tape formats: Geophysics, v. 32, no. 6, p. 1073–1084, illus., 1967.

One of the problems faced by contractor and major company alike is the recording and processing of multi-formats on digital tape. This is the report of a Field Tape Subcommittee charged with recommending a standard 9-channel field tape format. One feature—how gain information should be recorded—dictated the necessity of establishing two standard seismic data block formats, used with a common header block. The header block, format A (30 channels), and format B (more than 30 channels) are described. An Exchange Tape Format Subcommittee makes further recommendations which would facilitate processing of data acquired by trading, acquisitions, mergers, and joint exploration ventures. Substantial sums of money, computer time, and programming effort can be saved if the geophysical industry will adopt a standard format for interchange of seismic data as well as for recording and filing of seismic data.—DBV

Norton, Stephen A. *See* Hatch, Norman L., Jr. 04896

Nowlan, Gary A. *See* Post, Edwin V. 05291

05287 **Nugent, L. E., Jr.** Reply [to discussion by Richard H. Hopkins of "Critical analysis of stack seismic systems", 1967]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2476, 1967.

In reply to Hopkins' discussion (ibid., p. 2475) Nugent reiterates that the effect of near-surface conditions and misinterpretation of geophysical data can result in serious errors in using stack seismic systems.—WCC

05238 **Nutalaya, Prinya.** Metamorphic petrology of a part of the northeastern Front Range, Larimer County, Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1582B-1583B, 1967.

00016 **O'Brien, Neal R.** Field geology program for high school students: Earth Sci., v. 21, no. 1, p. 25-30, illus., reprinted 1968; originally published 1966.

This was reprinted from Jour. Geol. Education, v. 14, no. 2, p. 51-53, 1966 (Abstracts of North American Geology, January 1967).—ESL

O'Connell, R. *See* Anderson, Don L. 05178

04952 **Oeschger, H.; Alder, B.; Langway, C. C., Jr.** An *in situ* gas-extraction system to radiocarbon date glacier ice [with French and German abs.]: Jour. Glaciology, v. 6, no. 48, p. 939-942, 1967.

A new down bore-hole instrument to extract atmospheric gases entrapped in glacier ice was designed, developed and tested in a Greenland ice tunnel. Using this ice and a 7.5kW. source, about 30 hr are required to melt the approximately 1 metric ton sample, extract the gases, and to separate and collect with molecular sieves the minimum of 100 cm^3 of CO_2 necessary for the C-14 measurements made later using special low-level counters. Age results using the down bore-hole CO_2 samples agree with results obtained earlier from CO_2 samples collected at the same tunnel location using a vacuum-vessel melting technique. A mean value of 5,120±200 yr B.P. is obtained for the seven samples measured using both collecting systems, making this the oldest natural polar glacier ice measured to date.—Authors' abstract

05090 **Oja, R. V.** Geochemical investigations of the Thunder Bay silver area, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 211-221, illus., tables, 1967.

Considerable research in the mainland belt of silver mineralization is required to unravel some of the structural-geochemical problems related to silver deposition in the Thunder Bay area, northwestern Ontario. It is not known whether silver mineralization is confined primarily to the Rove argillites. Geophysical techniques tested to date seem to be inadequate to detect silver-bearing veins in the mainland area of highly conductive, flat-lying argillaceous sediments. Even very sensitive magnetic surveys do not reveal fault zones better than aerial photographs. The only hope of ore detection seems to lie in the use of geochemistry, but results to

date indicate the need for a cautious approach to final analysis of geochemical surveys.—MST

05403 **O'Keefe, John A.** Tektite sculpturing, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1931–1933, illus., 1967.

Tektites are divided into three types on the basis of external form: Type A (Muong Nong), Type B (spheres, teardrops, dumbbells, etc.), and Type C (derived from Type B forms but with evidence of aerodynamic ablation). The surface sculpturing of Type B tektites (grooves, pits, notches) is ascribed to aerodynamic processes rather than to chemical etching after arrival on the surface of the Earth.—Author's abstract

Olsen, E. *See* Fuchs, Louis H. 05397

04973 **Olson, C. C.** Technical advancement four decades of D.S.T., *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. M1–M11, illus., 1967.

Early day (1926) pressure recordings were disregarded in favor of recovery until about 1951, at which time the first steps were made to utilize the pressure charts for the application of the then existing mathematical equations to advance Drill Stem Testing into a scientific formation evaluation process. Increased well data comes when Drill Stem Testing supplements electric logging, supplying data which is unattainable by logging alone. Also reviewed are methods and procedures used to obtain productivity, permeability, well bore damage (damage ratio), potential production capabilities, radius of investigation during test, potentiometric surface, and on some tests depletion and barriers will be detectable. Procedure suggestions will be given to best obtain maximum benefits from modern (1966) Drill Stem Tests.—*from* Author's abstract

05239 **Olson, Edwin Andrew.** The problem of sample contamination in radiocarbon dating [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1582B, 1967.

05402 **Olson, R. J.; Oró, J.; Zlatkis, A.** Organic compounds in meteorites—[Pt.] 2, Aromatic hydrocarbons, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1935–1948, illus., tables, 1967.

Benzene eluate fractions from chromatographic separations of extracts from carbonaceous chondrites and a few other samples have been examined for volatile organic components by high resolution capillary gas–liquid chromatography. A few meteorites give evidence of small amounts of aromatic hydrocarbons, but most show only traces. The amount present is apparently not directly related to the Wiik class nor to the amount of alkanes, but when aromatic components are present, they are of relatively low molecular weight in Type I meteorites and of somewhat higher molecular weight in Types II and III. The benzene eluate fractions found in some meteorites are made up of large numbers of components (60–140) in relatively uniform concentrations.—*from* Authors' abstract

05141 **Orlin, Hyman.** Gravity sensing instruments, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 351–355, 1967.

Since 1963 gravimetry in the United States has advanced in almost all phases. A new absolute value of gravity, determined by the free-fall method for station NBS-2 at Gaithersburg, Maryland, is 980.1150 gals, which is 13.2 mgal less than the Potsdam-referred value for NBS-2. Underway shipboard systems have improved to the point where errors due to navigation may be greater than those inherent in the gravity meter system. Instruments have been developed which can measure gravity on the sea floor with a precision of ±0.005 mgal at any depth. A bibliography of pertinent works is given.—DBV

Oró, J. *See* Olson, R. J. 05402

05176 **Orowan, E.** Seismic damping and creep in the mantle, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne,

1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 191–218, illus., 1967.

A unified theory of viscosity and viscoelasticity of the molecular-rearrangement type is given in which the phenomena appear as special cases. With the Becker distribution of relaxances, the distribution function of activation energies is a constant, viscoelastic creep is logarithmic, and specific damping $1/Q$ is frequency-insensitive in wide ranges of time and frequency. It is shown that grain boundary viscosity should be relatively low, whereas crystal grains should be very hard in the deep mantle, and these factors can account for creep and damping properties of the middle and deep mantle. The high damping and low viscosity in the low-velocity layer seem to be due to a phase transition. There appears to be a drastic decrease of both in the presence of a phase transformation.—DBV

05181 **Orowan, E.** Island arcs and convection, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 385–395, illus., 1967.

If island arcs are outcrops of compressive faults, they cannot be products of a uniform field of compressive stress because their symmetry is lower. The polarity of the curvature, however, is provided if compression is of convective origin. Incipient faulting is then followed by convergence of convective flow towards the fault, causing convergence of initially parallel stress trajectories. Since the fault propagates at right angles to the trajectories of maximum compressive stress, its outcrop becomes an arc convex towards the upstream side. In oceanic compressive faults due to convection, the two conjugate fault planes are not equivalent because overthrusting of downstream by upstream side would lead to accumulation of a thick crust which would inhibit progress of faulting along the plane, and because underthrusting is lubricated by decomposing serpentine, fluxed basalt, etc.—*from* Author's summary

Osberg, Philip H. *See* Hatch, Norman L., Jr. 04896

05020 **Osborne, F. Fitz.** Guettard's map of 1752 [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 92, 1967.

05435 **Östrem, G.; Bridge, C. W.; Rannie, W. F.** Glacio-hydrology, discharge and sediment transport in the Decade Glacier area, Baffin Island, N.W.T.: Geog. Annaler, v. 49A, nos. 2–4, p. 268–282, illus., tables, 1967.

Mass balance studies were initiated in 1965 on the glacier, near the head of Inugsuin Fiord on the east coast. Measurements of accumulation and ablation gave average figures of 25 cm and 21 cm respectively, so the 1965 budget was slightly positive. Discharge measurements showed a close connection with rainfall, whereas warmer air gave only a small rise. A similar pattern was obtained for a river draining an almost glacier-free area. Sediment load was measured in the Decade River, draining 12.8 km^2 of which 8.7 km^2 is glacier-covered. Sediment transport varied from a few km a day to 1183×10^3 kg a day. The latter was 60 percent of the total during the whole observation period.—*from* Authors' abstract

Ottinger, N. H. *See* Edwards, J. M. 04895

05017 **Ottmann, Lianne.** La néo-tectonique—Essais de représentation graphique [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 98, 1967.

05105 **Pajari, G. E.; Trembath, L. T.** Geochemical control of copper deposition on Grand Manan Island, Bay of Fundy, New Brunswick [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 274, 1967.

05305 **Pankratz, L. B.; Weller, W. W.** Thermodynamic properties of three lithium-aluminum silicates: U.S. Bur. Mines Rept. Inv. 7001, 13 p., illus., tables, 1967.

Heat capacities of α- and β-spodumene and of β-eucryptite are tabulated over the temperature range 51° to 298°K. Entropies at 298°K were found to be 30.9 ± 0.2

cal/deg mole for α–spodumene, 36.9±0.3 cal/deg mole for β–spodumene, and 24.8±0.2 cal/deg mole for β–eucryptite. High–temperature heat contents were measured to 1,150°K for α–spodumene, 1,600°K for β–spodumene, and 1,470°K for β–eucryptite. Heats and free energies of formation from the elements and from the oxides are tabulated. All three compounds show considerable stability with respect to their constituent oxides. Alpha spodumene is less stable than beta spodumene above about 1,000°K.—KFF

04961 **Parry, J. T.** Geomorphology in Canada: Canadian Geographer, v. 11, no. 4, p. 280–311, illus., tables, 1967.

Catastrophism influenced writings on Canadian landscape until Lyell's visits to North America in the 1840's. The Geological Survey of Canada was established in 1842 for examination of mineral resources and to survey all provinces, and the period from 1850–1900 was marked by significant contributions to geology and physiography from field expeditions and surveys. The Survey published *Geology of Canada* in 1863 and encompassed the western provinces in 1870. Study of geomorphology was not accepted as part of college curricula until physical geography gained status at the University of British Columbia in 1915, but geomorphology was subordinate to geography until the 1940's. The Geographical Bureau, established by the federal government in 1947 became a Branch in 1950, lending support to more field investigations. Canadian contributions to the literature have been mainly in glacial geomorphology and glaciology.—MCM

04893 **Paul, R. H.** Log interpretation in complex gas bearing reefs, northeast British Columbia, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. J1–J13, illus., 1967.

Large vugs in the Slave Point Dolomite in the Fort Nelson area render acoustic–type devices almost useless. Neutron logs are superior under controlled conditions. Neutron–core porosity plots indicate that readings vary logarithmically with porosity. Density logs can be used to calculate porosity which is less than 10 percent. Acoustic logs vs. core porosity plots show that wide variations occur in matrix velocity and apparent fluid velocity. Resistivities from induction or laterolog type devices do not approach R_o in water–laden zones, because of abnormally high gas saturation in the water zone. Therefore, water comes from zones with a calculated S_w as low as 14 percent. Greater discrimination between fluids comes from laterologs than from induction logs. Lab–determined values of cementation and saturation are needed in this field.—*from* Author's abstract

05336 **Payne, J. G.; Shaw, D. M.** K–Rb relations in the Blue Mountain nepheline syenite: Earth and Planetary Sci. Letters, v. 2, no. 4, p. 290–292, illus., table, 1967.

Nepheline syenite of Blue Mountain, Ontario, shows unusual fractionation of K and Rb. It has an average K/Rb ratio of 490; values increase from between 400 to 500 in early formed rocks to between 700 and 800 in late formed rocks. Pegmatite off–shoots have an average K/Rb ratio of 235.—Authors' abstract

00014 **Pease, Maurice H., Jr.** Summary report on the geology and mineral resources of the Edmunds Unit, Moosehorn National Wildlife Refuge, Washington County, Maine: U.S. Geol. Survey Bull. 1260–P, p. P1–P18, illus., table, 1968.

Bedrock in the Edmunds Unit, chiefly volcanic rocks of the Dennys Formation, also includes exposures on Dog and Bitch Islands of the younger Edmunds Formation, both Silurian. Numerous diabase dikes intrude both formations, and granite is exposed in the western part. Pleistocene deposits of till, outwash, and marine clay blanket most bedrock in the mainland area. Volcanic rocks strike NW and dip NE; they are strongly jointed and fractured, and large–scale faulting may be present. No zones of intense alteration or significant mineral deposits have been observed. Sand, gravel, and clay are the only known mineral resources of economic value. Subsurface exploration would be necessary to determine whether commercial deposits of metals underlie weak geochemical anomalies in the volcanic rocks.—*from* Author's abstract

05211 **Pecora, William T.** Surveying the Earth's resources from space: Surveying and Mapping, v. 27, no. 4, p. 639–643, 1967.

Experiments have demonstrated our ability to study and assess natural resources from remote-sensored data. Examples discussed are: mapping; geographical research; hydrogeology, such as salt-water intrusion and pollution; mineral and fuel discoveries; and engineering geology. Some examples are given of the use of infrared imagery in Nevada, Yellowstone Park, and Scranton, Pa., where underground coal beds are burning. Radar has located faults in a mining area in Nevada. This data can help also with conservation of public lands and forests, and in oceanography.—ESL

Peippo, Johan. *See* Arnborg, Lennart. 05337

04919 **Peper, John D.** Stratigraphy and structure of the Monson area, Massachusetts and Connecticut, Trip G *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ., Dept. Geology] p. 105–113, illus., 1967.

The Monson, Mass., area, including an adjoining portion of northern Connecticut, is immediately east of the Triassic border fault of the Connecticut Valley. The area lies along the Bronson Hill anticlinorium, a major belt of en echelon gneiss domes, mantled by Ordovician to Devonian volcanic and metamorphosed sedimentary rocks, and cut by discordant Paleozoic and Triassic intrusions. In the Monson area, the anticlinorium consists of, from west to east, the Wilbraham syncline, Glastonbury dome, Great Hill syncline, Monson anticline, and an unnamed syncline. Stratigraphy of the Ordovician–Devonian sequence was interpreted in part by correlation with fossiliferous rock units in western New Hampshire. This field trip is intended as a review of the lithologic character of rock units of the Monson area and the criteria for mapping them.—VMJ

00012 **Perdue, Charles L., Jr.** Summary report on the geology and mineral resources of Passage Key, Island Bay, Cedar Keys, and Pelican Island National Wildlife Refuges, Florida: U.S. Geol. Survey Bull. 1260-O, p. O1–O13, illus., tables, 1968.

The refuges, consisting of islands and associated sandbars along coastal Florida, are underlain by a thick sequence of limestone, clay, sand, chalk, shale, and anhydrite that ranges in thickness from at least 5,000 feet under Cedar Keys to more than 13,000 feet under Island Bay. The island surfaces are mostly mangrove swamps or sand and sea shells. No mineral deposits are known in nearby parts of Florida, and there is no evidence to suggest any at minable depths on the refuges. The Miocene Hawthorn Formation, which underlies three of the refuges (absent under Cedar Keys), is sparsely phosphatic and could be a future source of phosphate. Oil and gas potential is considered slight.—*from* Author's abstract

05240 **Perkins, Robert Lee.** Tectonites from the Blue Ridge and Great Valley of West Virginia and northwestern Virginia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1583B, 1967.

Perry, T. G. *See* Bork, Kenneth B. 04903

05314 **Peterman, Zell E.; Hedge, Carl E.; Coleman, Robert G.; Snavely, Parke D., Jr.** Sr-87/Sr-86 ratios in some eugeosynclinal sedimentary rocks and their bearing on the origin of granitic magma in orogenic belts: Earth and Planetary Sci. Letters, v. 2, no. 5, p. 433–439, illus., tables, 1967.

Rb and Sr contents and Sr-87/Sr-86 values were determined for samples of eugeosynclinal sedimentary rocks, mostly graywackes, from Oregon and California. These data are compatible with the theory of anatexis of eugeosynclinal sedimentary rocks in orogenic belts to produce granitic magmas provided that the melting occurs within several hundreds of m.y. after sedimentation. The low $(Sr\text{-}87/Sr\text{-}86)_0$ values of the eugeosynclinal sedimentary rocks are related to the significant amounts of volcanogenic detritus present which probably were originally derived from the mantle.—Authors' abstract

04979 **Peters, C. M. F.** Instruments and geological interpretations for a sub-bottom survey in San Francisco Bay, California: Eng. Geology, v. 4, no. 2, p. 54–69, illus., table, 1967.

A marine seismic survey was made of the San Francisco to Oakland tube alignment. The geologic units underlying San Francisco Bay are an older bedrock sequence of the Jurassic Franciscan Formation, and a younger unconsolidated sedimentary sequence—the so-called "Bay muds". The tube excavation will be in the Bay mud which contains soft, weak, plastic silty clay, clayey silt, and silt. Many types of acoustical sounding devices were evaluated. Their performance was found to depend upon penetration and resolution which is a function of the frequency and character of the output signals. A high resolution boomer was selected. As a result of the survey, core data was correlated with the seismic profile, the lithologic horizons defined, and calculations made of volume of material to be excavated.—*from* Author's abstract

05292 **Petersen, Richard G.; Shaw, Charles E., Jr.** Surficial geologic map of the Whitman quadrangle, Plymouth County, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-632, scale 1:24,000, text, 1967.

Glacial deposits of stratified sand and gravel are divided into five distinct time-stratigraphic units and five units too local in extent to allow exact time correlations. However, these local units must belong to the same general period of deposition and might be grouped into two time units encompassing deposits of slightly different ages. An additional unit consists of clay, silt, and fine sand that accumulated in a glacial lake and contains facies equivalents of three and possibly four time stratigraphic units and of all local units. The configuration of the bedrock floor beneath the glacial deposits is shown on an inset map.—MCM

04901 **Peterson, Gary L.** Some comments regarding "Cretaceous pelecypods of the genus *Pinna* from the west coast of North America" by Packard and Jones [1965]: Jour. Paleontology, v. 41, no. 6, p. 1556, 1967.

The range of *Pinna pontica* as reported by Packard and Jones (ibid., v. 39, no. 5, p. 910–915, 1965), is incomplete; the species has a Hauterivian through Aptian age range. The holotype of *P. equivillana* may be from the *Beudanticeras hulense* Zone, not from the *Leconteites lecontei* Zone.—JP

Peterson, M. N. A. *See* Pushkar, Paul. 05424

05087 **Petit, Richard E.** Notes on Cancellariidae (Mollusca: Gastropoda): Tulane Studies Geology, v. 5, no. 4, p. 217–219, illus., 1967.

Two generic names, *Bivetia* and *Ventrilia*, that have been misunderstood and out of use are discussed. One new generic name, *Agatrix*, is proposed and *Cancellaria depressa* Dall, a preoccupied specific name, is replaced [by *Trigonostoma tampaensis*; this species is from the lower Miocene "silex bed" of the Tampa Limestone in Florida].—Author's abstract

04910 **Petocz, R. G.** Preliminary observations on Fusulinidae from east-central Alaska Range: Jour. Paleontology, v. 41, no. 6, p. 1547–1549, illus., 1967.

The fusulinid genera *Monodiexodina*, *Schwagerina*, *Pseudofusulinella*, and *Schubertella* have been found at different stratigraphic intervals from the Permian sequence in the Alaska Range. The fauna indicates a late Wolfcamp–early Leonard age.—RCD

05204 **Pettyjohn, Wayne A.; Randich, P. G.** Hydrologic applications of lithofacies clastic-ratio maps: South Dakota Acad. Sci. Proc. 1967, v. 46, p. 48–60, illus., tables, 1967.

A sequence of lithofacies clastic-ratio maps will reveal the stratigraphy of an aquifer. The use of these maps in conjunction with a study of the water-level fluctuations of wells and streams will aid in determining the relationship of surface water and ground water. In addition, these maps should indicate boundaries and water-table

or artesian conditions of aquifers. They may also provide information concerning changes in quality of ground water.—Authors' abstract

05205 **Pettyjohn, Wayne A.** Cretaceous rocks in eastern Pennington County, South Dakota: South Dakota Acad. Sci. Proc. 1967, v. 46, p. 41–47, illus., 1967.

The Cretaceous rocks that crop out in eastern Pennington County are the upper part of the Pierre Shale and the Fox Hills Formation. These strata are well exposed along the bluffs of the Cheyenne River and in the Creighton area. The upper part of the Pierre can be traced over wide areas due to the presence of several fossiliferous concretion zones. In this area the Fox Hills is a lower fossiliferous sandy shale herein called the Cheyenne River facies; the overlying Bullhead and "Colgate" Members, in most respects are similar to their other exposures elsewhere. Fossils can be collected from the upper members also. In many places these rocks are covered by the White River Group of Oligocene age or by chemically altered strata that represent an Eocene soil profile.—Author's abstract

05277 **Picard, M. Dane.** Reply [to discussion by Richard A. Davis, 1967, of "Paleocurrents and shoreline orientations in Green River Formation (Eocene), Raven Ridge and Red Wash areas, northeastern Uinta Basin," 1967]: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2471–2475, 1967.

Symmetrical ripple marks are useful in paleogeomorphologic reconstruction if used in large quantities, and in conjunction with other evidence (See Davis, ibid., p. 2470–2471).—WCC

Pierce, J. W. *See* Gross, M. Grant. 00006

05377 **Pifer, Drury A.; Ko, Kyung Chul.** Detonation pressure as a rock-breaking parameter: Trend Eng., v. 19, no. 4, p. 23–26, illus., tables, 1967.

Detonation of high explosives creates both shock wave and pressure in surrounding rock. This analysis examines the role of stress by pressure and its relation to rock strength, the theoretical size of spherical blast hole, and the detonating pressure of explosives vs. the rock displaced by blasting. Formulas are presented for the preliminary design of blasts from the determinable data covering these factors. Authors' abstract

Pinson, W. H., Jr. *See* Fairbairn, H. W. 05331

04888 **Pirson, S. J.; Trunz, J. P., Jr.; Gomez-N., P.** Fracture intensity mapping from well logs and from structure maps, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. B1–B23, illus., 1967.

Electric log techniques have been developed and tested on the Luling-Branyon-Buchanan field, Caldwell County, Tex., that permit evaluation of fracturing intensity in the Austin Chalk and the proximity to the fault surface responsible for it. It has been established that reservoir productivity is a function of fracturing intensity. Hence, the fracturing index should be an important mapping parameter for guidance of oil field development in such chalk fields as the Austin, Selma, Annona, etc., and in such sand fields as the Spraberry. An important oil and gas exploration aspect for fractured reservoir rocks is to point out where to expect the greatest probability of finding fracture development associated with certain tectonic deformations; model fracturing experiments and theoretical studies have permitted some preliminary conclusions.—*from* Authors' summary

Podosek, F. *See* Funk, H. 05379

05041 **Porter, Stephen C.; Denton, George H.** Chronology of neoglaciation in the North American Cordillera: Am. Jour. Sci., v. 265, no. 3, p. 177–210, illus., 1967.

Geological, botanical, and historical evidence, together with critical radiocarbon dates, permit reconstruction of a reasonably comprehensive picture of glacier fluctuations in western North America during the last three millennia. Following

recession and disappearance of many residual Wisconsin-age alpine glaciers during the warmest part of the Hypsithermal, resurgence of glacier activity led to a possible widespread early Neoglacial advance close to 4,600 years ago and to a major advance that culminated 2,600 to 2,800 years ago throughout the Cordilleran region. A long period of milder climate followed, during which most glaciers probably diminished in size. Glaciers throughout western North America again experienced marked advances during the last several centuries, and many attained their maximum Neoglacial positions. Recession has been general and rapid since the early 20th century.—*from* Authors' abstract

04953 **Post, Austin.** Non-earthquake origin of supraglacial debris on Martin River and Sioux Glaciers, Alaska [comments on paper by S. J. Tuthill, 1966]: Jour. Glaciology, v. 6, no. 48, p. 953–956, illus., 1967.

Although it has been suggested by Tuthill (ibid., v. 6, no. 43, p. 83–88, 1966) that former earthquake-avalanching is the primary source of debris on the lower part of Martin River Glacier, this appears unlikely. Except for small rock falls, the debris results from normal mass wasting of slopes onto the glacier to produce lateral, then medial moraines. Folding of medial moraines has spread the debris widely in the terminal area. Rock-like avalanches induced by the 1964 earthquake, though unprecedented in magnitude, form no basis for computing the contribution of earthquake-induced avalanching to supraglacial debris found near the terminus of many Alaskan glaciers. The 1964 earthquake spread, however, more than 1 km^2 of debris on the relatively clear ice of the nearby Sioux Glacier.—LLR

05291 **Post, Edwin V.; Lehmbeck, William L.; Dennen, William H.; Nowlan, Gary A.** Map of southeastern Maine showing heavy metals in stream sediments: U.S. Geol. Survey Mineral Inv. Field Studies Map MF-301, scale 1:250,000, text, 1967.

Southeastern Maine is underlain by metasedimentary and metavolcanic rocks of low metamorphic grade and mainly of Ordovician and Silurian age. Stratified rocks are intruded by a number of dominantly felsic Devonian plutons. Glacial drift covers much of the area and is thick in the south-central part where sandy outwash appears to subdue geochemical relief shown elsewhere on the map. Most base-metal occurrences lie in the coastal area extending northeasterly from Castine to Lubec. Statistical distribution of citrate-soluble heavy metal values reveals 5.5 percent of the values exceed 10 ppm and may be considered anomalous. In general the map shows only raw data. Many of the relatively high values were obtained from samples that contained appreciable concentrations of secondary black manganese-iron oxide. Further studies are suggested.—MCM

05027 **Pouliot, Gaston.** Paramorphisme du quartz dans le granophyre de l'intrusion Muskox [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 90–91, 1967.

Powell, N. J. *See* Runge, R. J. 04889

Pratt, Marilyn. *See* Menzel, Muriel. 00010

05091 **Presant, E. W.** A trace element study of podzol soils, Bathurst district, New Brunswick, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 222–232, illus., 1967.

Trace element contents are up to 100 times higher in soils above sulfide deposits than in soils above nonmineralized rocks. Arsenic, copper, and zinc are most enriched above sulfides; iron and manganese show the least enrichment. Major concentrations of lead and silver occur in the L–H horizons of most profiles, and minor amounts of manganese, zinc, and copper are present in many L–H horizons. Lead, zinc, and copper are bound to organic matter fractions in all horizons, probably as chelate complexes. Higher tin content occurs in the Ae horizons and may be due to its concentration in resistant oxide form. The lowest profile values for most elements are in the Ae horizons. Trace-element contents of B horizons are usually intermediate between those of the A and O horizons. Antimony, iron, and manganese are exceptions.—MST

05391 **Price, Don.** Ground water in the Eola–Amity Hills area, northern Willamette Valley, Oregon: U.S. Geol. Survey Water-Supply Paper 1847, 66 p., illus., tables, 1967.

Eocene to Recent rocks underlie the Eola–Amity Hills area: oldest are a sequence >5,000 feet thick of marine-deposited shale and siltstone and thin interbeds of sandstone, overlain by the Miocene Columbia River Group (average thickness 200 feet), then nonmarine sedimentary deposits—Pliocene Troutdale Formation, Pleistocene Willamette Silt, and alluvium of the Willamette River and tributaries. The Troutdale and river alluvium generally yield moderate to large quantities of water to wells; other aquifers yield small but adequate amounts for domestic and stock supplies. Ground water from the Columbia River Group and nonmarine sedimentary rocks is chemically suitable for irrigation and other uses, as is that from shallow depths in the marine rocks. Major problems affecting development include uneven areal distribution of permeable rocks, undesirable chemical quality locally, and fine sand entering wells tapping the Troutdale.—*from* Author's abstract

05424 **Pushkar, Paul; Peterson, M. N. A.** Strontium isotopic analyses of three marine phillipsites from the Pacific Ocean: Earth and Planetary Sci. Letters, v. 2, no. 4, p. 349–350, table, 1967.

Sr–87/Sr–86 ratios have been measured on three purified samples of phillipsite from sediment cores obtained in the deep Pacific. Phillipsite is found only in cores with volcanic debris or evidence of having contained volcanic debris. Results indicate that the chief governing factor for the Sr–87/Sr–86 ratios in phillipsite is the Sr–87/Sr–86 ratio in seawater, and that the interaction has been virtually complete during formation of marine phillipsite.—VSN

05313 **Pytkowicz, R. M.; Disteche, A.; Disteche, S.** Calcium carbonate solubility in seawater at in situ pressures: Earth and Planetary Sci. Letters, v. 2, no. 5, p. 430–432, table, 1967.

The pressure coefficient of the apparent solubility product of aragonitic oolites was measured at high pressures with *in situ* *p*H electrodes. The results confirmed earlier data obtained with a decompression technique. The effect of pressure on the dissociation of carbonate complexes was estimated. A gradual change in the surface of the oolites at one atmosphere was inferred from the time behavior of the *p*H. *p*H measurements showed that solution of calcitic foraminifera occurs already at 100 atm, a pressure well below that found at the compensation depth.—Authors' abstract

Radke, L. F. *See* Hobbs, P. V. 04955

04956 **Radke, L. F.; Hobbs, P. V.** The strength–density relationship for dry snow [with French and German abs.]: Jour. Glaciology, v. 6, no. 48, p. 893–896, illus., 1967.

A linear relationship between strength and density is a characteristic feature of deposited snow. This relationship is explained theoretically in the case of old dry snow in terms of the theory of sintering. The discontinuity in the relationship at a density of about 0.4 g/cm^3 is considered to mark a transition point below which the snow densifies primarily by rearrangement of the grains and the strength increases by the growth of existing bonds, and above which densification occurs by volume diffusion and the strength increases primarily by the creation of new bonds. Experimental evidence to support these ideas is presented.—Authors' abstract

05431 **Raikes, Robert.** Water, weather and prehistory: New York, Humanities Press, Inc., 208 p., illus., 1967.

The book is divided into three parts: Part 1, the role of water in environment reviews hydrology and the hydrologic cycle, and discusses water and climate as agents of geomorphology and as ecological factors. Part 2 covers the effect of postglacial climate and water resources on early human societies. Case studies in Baluchistan comprise Part 3. An epilogue discusses the interdisciplinary approach.—ESL

05031 **Raleigh, C. B.; Talbot, J. L.** Mechanical twinning in naturally and experimentally deformed diopside: Am. Jour. Sci., v. 265, no. 2, p. 151–165, illus., 1967.

Lamellar twinning on (100) and to a lesser extent on (001) are present in clinopyroxenes of deformed mafic and ultramafic rocks. Twins having similar appearance and orientation have been produced in deformation experiments at a confining pressure of 5 kb and temperatures up to 1000°C. The twinning elements and shear strain for each twin-glide system have been determined by a technique described herein. For the narrow, closely spaced twins on (100), K_1, the twin-glide plane, = (100), η_1, the twin-glide direction, = [001], K_2 = (001), η_2 = [100], and s = 0.57. For the broader, discontinuous twins on (001), K_1 = (001), η_1 = [100], K_2 = (100), η_2 = [001], and s = 0.57.—*from* Authors' abstract

05164 **Raleigh, C. B.** Tectonic implications of serpentinite weakening, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 113–118, illus., 1967.

The observation that serpentinite becomes weak and brittle at its dehydration temperature provides an experimental basis for the hypothesis that mantle earthquakes are caused by shear fracturing where interstitial fluid pressure (due to interstitial magma) effectively reduces frictional resistance to a negligible value. If convection currents in the mantle turn down at foredeeps of Pacific island arcs, dehydration of an oceanic crust of serpentinite and downward convection of dehydration products beneath arcs would give rise to anomalously low shallow mantle velocities and heat-flows between trenches and arcs. Seismic activity would be confined to the zone along which dehydration products move downward against immobile continental mantle and would be concentrated at the leading edge of the focal zone due to release of stored elastic strain upon initiation of weakening.—*from* Author's summary

05184 **Raleigh, C. B.** Plastic deformation of upper mantle silicate minerals, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 45–49, illus., tables, 1967.

Several minerals which from their occurrence in nodular inclusions in basalts and on theoretical grounds are believed to occur in the upper mantle have been deformed experimentally at high temperature and pressure. The glide mechanisms on which olivine crystals in naturally occurring aggregates are deformed operate in the experimentally deformed specimens in addition to other glide mechanisms which occur naturally only in meteorites. The glide mechanisms which predominate in olivine are shown to be a function of temperature and strain-rate. Diopside deforms chiefly by mechanical twinning in the experiments and enstatite by slip and shear-transformation to clinoenstatite.—Author's summary

Ramo, A. O. *See* Fairbairn, H. W. 05331

Randich, P. G. *See* Pettyjohn, Wayne A. 05204

Rannie, W. F. *See* Östrem, G. 05435

05318 **Rao, M. N.** Abundance pattern of the rare earth elements in uranium minerals: Earth and Planetary Sci. Letters, v. 2, no. 5, p. 394–396, illus., 1967.

Distribution patterns of rare-earth elements in samples from uranium assemblages described in the literature and regularities in distribution of these elements in uraninites and pitchblendes are discussed. The average total content of REE in pitchblendes seems to be 0.1 percent, in uraninites from 1 to 10 percent depending on thorium content and conditions of mineralization. Europium is shown to be depleted in uraninite but in normal abundance in pitchblendes; the significance of this in interpretation of the nature of hydrothermal solutions from which pitchblende deposits are derived is examined—VSN

05275 **Rau, Weldon W.** Geology of the Wynoochee Valley quadrangle, Grays Harbor County, Washington: Washington Div. Mines and Geology Bull. 56, 51 p., illus., tables, geol. map, 1967.

Within this area north of Montesano, the oldest rocks exposed are the middle Eocene Crescent Formation of pillowed basalt flows interbedded and overlain by marine siltstone and sandstone. The overlying late Eocene sedimentary rocks are correlated by foraminifers referred to the Narizian Stage of Mallory (1959); the Astoria(?) Formation of Miocene age has three foraminiferal zones informally named from recognized species of *Siphogenerina, Baggina, and Rotalia.* Above are the Montesano Formation of late Miocene age, and Quaternary deposits including high masses of Pleistocene(?) gravels and valley landslide debris and Recent alluvium. Several periods of folding and faulting have affected rocks of pre-Montesano age, particularly in the northwest, and in other parts Montesano rocks as well. Oil and gas possibilities are the principal economic interest.—GDC

Raup, Robert B. *See* Hayes, Philip T. 00029

Raychaudhuri, B. *See* Bhattacharyya, B. K. 05355

04996 **Raymond, René.** La carte géopédologique de la région du lac Saint-Jean—Nature des roches-mères et dévelopment morpho-génétique des profils de sols [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 99, 1967.

05025 **Raymond, René.** Le problème de la cartographie des sols dérivés de l'altération des formations schisteuses de la région de Métis [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 15, 1967.

04975 **Redfield, Robert C.** Brantley Reservoir site—An investigation of evaporite and carbonate facies: Eng. Geology, v. 4, no. 2, p. 14-30, illus., 1967.

The reservoir will be on Pecos River in New Mexico. Middle Permian evaporites, clastics, and carbonates are facies of one another and change within a few hundred to a few thousand feet. They dip homoclinally, disrupted locally by evaporite solution; much karst is present also. Coring, percolation tests, water sampling, electric and gamma-ray logging, and water table measurements were used to delineate evaporite and carbonate facies to show that carbonates are a ground water barrier, and to determine the acceptability of the site for storage. The dam will be on sound carbonate where evaporites are deep; grouting can close joints and bedding plane crevices. The reservoir is on cavernous evaporite and pervious breccia but abuts against tight carbonates downdip.—*from* Author's abstract

05347 **Reilly, G. A.; Shaw, D. M.** Erratum—An estimate of the composition of part of the Canadian Shield in northwestern Ontario (1967): Canadian Jour. Earth Sci., v. 4, no. 6, p. 1269, 1967.

Corrections are given to map-area numbers and longitude on the map published by these authors in an article of this title (ibid., v. 4, p. 725-740, 1967).—HRC

Reitzel, J. S. *See* Gough, D. I. 04959

05021 **Remic, Jérome H.** L'usage de l'hélicoptère dans la cartographie régionale [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 92, 1967.

05241 **Renard, Vincent Paul Augustin.** Virgin Bank—Correlation of magnetism and gravity with geology [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1583B, 1967.

05279 **Richards, Horace G.** Stratigraphy of Atlantic Coastal Plain between Long Island and Georgia—Review: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2400-2429, illus., tables, 1967.

The coastal plain is divided into nine major structural features that are described briefly. The various formations in the different states, mainly of Cretaceous and Tertiary ages, are described briefly, and correlations with other states or regions

of the coastal plain are suggested. Triassic rocks underlie coastal-plain strata in parts of Maryland, South Carolina, and Georgia. Buried Paleozoic rocks are present in parts of Georgia. Some oil seeps have been reported from Georgia, but oil in commercial amounts has not been found in the coastal plain.—WLA

05092 **Riddell, J. E.** Geochemical dispersion patterns in soils at Mount Pleasant mines, Charlotte County, New Brunswick, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 233-248, illus., 1967.

Maps of dispersion patterns in soils have been prepared for the elements tin, zinc, copper, molybdenum, and lead for a 2 sq mi area of Mount Pleasant mines. The area is underlain by mid-Carboniferous altered volcanics and acidic intrusives. Mineralization of the bedrock is widespread. The area is covered with alluvial and colluvial soils from glacially disturbed soils which had previously been subject to the normal processes of mass wasting in preglacial time. As a result of these conditions it has been difficult to make interpretations of the distribution of the metals in the soils. This study shows the necessity of evaluating the geomorphic and geological history of an area before attempting a unique interpretation of the relationship of soil anomalies to bedrock mineralization.—MST

00013 **Rife, David L.** Cincinnatian paleocurrents near Newport, Kentucky: Earth Sci., v. 21, no. 1, p. 22-24, illus., 1968.

Sections parallel to current direction, etched on megaripples in the Ordovician Cincinnatian Series across the Ohio River from Cincinnati, show that each one possesses a distinct internal cross-stratification. Average wavelength of megaripples in the Kope Formation is 93.2 cm contrasted with 79.5 cm for those in the Fairview. The ratio between crestal height and wavelength is about the same for both, suggesting a time-transgressive shallowing sea. Crossbedding and channel fills, studied in the same manner, provided the best indication of current differences between the formations. The mean trend of Kope paleocurrents is west-southwest, and of Fairview, southeast. The environment was probably a shallow backshore, with variable wind- and storm-generated currents as well as tidal currents. Cross-stratification in the ripples was caused by scour, diametric to mean current trend, of tidal-formed current ripples.—ESL

05016 **Ritchot, Gilles.** Le problème de la néo-tectonique en Gaspésie [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 97-98, 1967.

05280 **Rittenhouse, Gordon.** Bromine in oil-field waters and its use in determining possibilities of origin of these waters: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2430-2440, illus., 1967.

Oil-field waters can be subdivided into at least five groups on the basis of bromine and total-solids content. The relationship between bromine and total solids can be used to determine the origin of some oil-field waters, particularly those that owe their high salinity to solution of salts or to evaporation.—WCC

05218 **Robert, Jean-Louise.** Geology of Lesseps Creek area, Gaspé-North county [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 562, 16 p., table, geol. map, 1967.

The map-area is underlain by Ordovician and Silurian-Devonian sedimentary rocks, intruded by sills and dikes. The Ordovician is exposed in the north and dips steeply south. The Silurian-Devonian rocks are folded into a southwesterly plunging syncline. A large alteration zone crosses the map-area south of the McGerrigle granite intrusion. There are three main faults; one along the Lesseps Creek valley cuts across the nose of the syncline. Mineralization in Ordovician and Silurian rocks is discussed; a drilling program is being carried out on one copper showing.—ESL

05076 **Roberts, Michael C.** River terraces of the Middle Humber River, Ontario: Iowa Acad. Sci. Proc. 1965, v. 72, p. 298-304, illus., 1967.

The terraces of the river valleys in southern Ontario provide one way of establishing at least part of the denudation chronology of the region. The paper reports the findings of an investigation centered on the Middle Humber Basin, west and north of the city of Toronto. Two areas, within the basin, were studied extensively—the Kleinburg–Elder Mills area and the Woodbridge area. A threefold terrace sequence was established; alternation in lake level was found to be the key factor. Levels found at 525 feet, 465–475 feet, and 420 feet mark falling lake levels, the highest terraces the oldest and the lowest the youngest.—*from* Author's abstract

05242 **Robinson, Paul Thornton.** Cenozoic stratigraphy and structure of the central part of the Silver Peak Range, Esmeralda County, Nevada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1583B–1584B, 1967.

04897 **Robinson, Peter.** Gneiss domes and recumbent folds of the Orange area, west central Massachusetts, Trip B *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ., Dept. Geology] p. 17–47, illus., geol. maps, 1967.

The Orange area occupies a portion of the Bronson Hill anticlinorium, a complex zone of gneiss domes and recumbent folds extending from northwestern Maine to Long Island Sound; the chief purpose of this trip is to show results of mapping structural features in an intensely deformed region provided with excellent stratigraphic interpretation. Stratigraphy of the Ordovician to Devonian mantle rocks and of the older gneisses of uncertain age in the dome cores is summarized; the problem of origin and age of the dome cores is discussed. Tectonic events are outlined; domes, recumbent fold structures, including the Skitchewaug nappe, and linear features are described. Additional detailed descriptions of some rocks and structures are given in the 20-page road log. A generalized geologic map, several detailed ones, and structural relief diagrams are included.—VMJ

04900 **Robinson, Peter.** The mandibular dentition of *?Tetonoides* (Primates, Anaptomorphidae): Carnegie Mus. Annals, v. 39, art. 13, p. 187–191, illus., 1967.

The fragment of a left jaw with the entire tooth row represented (9 teeth) is described and illustrated; it was collected from the lower beds (Graybull) of the Eocene Willwood Formation in the Bighorn Basin of Wyoming. No species assignment is made because of the lack of comparative material. Details of the teeth are described. The importance of this specimen, an early Eocene primate with a vestigial P_2, is in ascertaining the identity of teeth in other specimens of the Anaptomorphidae. Comparison of this genus and family with others is made. The large anterior tooth of the anaptomorphid jaw is an I_2, and canines, if present, are premolariform. These dental characters separate the Anaptomorphidae from the Tarsiidae.—HRC

04920 **Robinson, Peter.** Geology of the Quabbin Reservoir area, central Massachusetts, Trip H *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ., Dept. Geology] p. 114–127, illus., geol. maps, 1967.

The Quabbin Reservoir area, immediately south of the Orange area, is an integral part of the Bronson Hill anticlinorium; the regional structure including both areas is described in Trip B (Robinson, ibid., p. 17–47). Wave action on the steeper shores of the reservoir, which was flooded in 1940, has stripped off the veneer of Pleistocene drift, leaving a series of outcrops unparalleled in this region for detailed study of structural and petrologic features. Structure of the area is dominated by several generations of north–south trending anticlines and synclines. Stratigraphy is similar to that of the Orange area; Ordovician to Devonian metasedimentary rocks are draped over gneiss domes. Detailed descriptions of small-scale structures and rock fabrics given in the log are illustrated by several detailed small-scale geologic maps.—VMJ

Robinson, Peter. *See* Guthrie, James O. 04922

Robinson, Peter. *See* New England Intercoll. Geol. Conf. 04935

04936 **Robinson, Peter.** Introduction to the geology of the Connecticut Valley of Massachusetts, *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ., Dept. Geology] p. 1–4, illus., 1967.

This meeting commemorates the work of Benjamin Kendall Emerson on the fiftieth anniversary of his last major publication, "The geology of Massachusetts and Rhode Island" (1917); in this and earlier works, especially "The geology of Old Hampshire County, Massachusetts" (1898), Emerson made major contributions to the Precambrian to late Pleistocene geology of the Connecticut Valley. His Massachusetts bibliography, compiled by M. Cassidy, is cited separately. M. P. Billings (1937) traced fossiliferous formations in New Hampshire into progressively more metamorphosed and structurally complex regions; this guidebook contains the first full coverage of application of this work to interpretation of geology of the Connecticut Valley and adjoining highlands. Bedrock and surficial geology are briefly outlined, with references to the 12 field trips cited separately.—VMJ

05043 **Robinson, Peter.** Discussion—A study of equilibrium relations in the systems Al_2O_3–SiO_2–H_2O and Al_2O_3–H_2O [discussion of paper by S. Matsushima and others, 1967]: Am. Jour. Sci., v. 265, no. 9, p. 831–832, 1967.

In a paper by Matsushima, Kennedy, Akella, and Haygarth (ibid., p. 28–44, 1967) the graphical presentation of experimental data has glossed over changes in slope at invariant points. Correct slopes based on thermodynamic data are shown on a diagram.—RWT

05006 **Robitaille, Benoit.** Problèmes géomorphologiques de l'île Akpatok, baie d'Ungava [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 100, 1967.

05056 **Rodgers, John.** Chronology of tectonic movements in the Appalachian region of eastern North America, *in* Symposium on the chronology of tectonic movements in the United States: Am. Jour. Sci., v. 265, no. 5, p. 408–427, table, 1967.

The Appalachian orogenic cycle consisted of spasmodic orogenic episodes from late Precambrian through late Paleozoic. Three major episodes, the Ordovician Taconic orogeny, the Devonian Acadian orogeny, and the Pennsylvanian Alleghanian orogeny are recognized. The Precambrian Grenville orogenic cycle preceded the Appalachian cycle. Late Triassic block faulting and rift-valley formation, the Palisades "disturbance," terminated the Appalachian cycle.

04962 **Roehl, Perry O.** Stony Mountain (Ordovician) and Interlake (Silurian) facies analogs of Recent low-energy marine and subaerial carbonates, Bahamas: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 10, p. 1979–2032, illus., 1967.

The Stony Mountain Formation and Interlake Formation dolomites were deposited during Late Ordovician and Silurian times as epeiric carbonate sediments over a negative metastable lineament of the western Williston Basin. The original sedimentary and early diagenetic fabrics are analogous with modern platform infratidal, intertidal, supratidal, and subaerial diagenetic terrane deposits of the Bahama Islands. Supratidal and subaerial diagenetic terrane remnants are most diagnostic, having several distinct microfacies fabrics. A generalized working model of low-energy facies relations is presented.—WCC

05308 **Romer, Alfred Sherwood.** Early reptilian evolution re-viewed: Evolution, v. 21, no. 4, p. 821–833, illus., 1967.

Classification of reptiles has been customarily based on the temporal openings of the skull (Williston, 1925). Romer (1933–1966) and most recent authors follow this system with necessary modifications, but two divergent systems, those of D. M. S. Watson (1954,1957) and F. vonHuene (1956), deserve consideration. Watson divides reptiles into Sauropsida, having an otic notch inherited from amphibians, and Theropsida, lacking the notch. But the otic notch in amphibians is high on

the skull, above the squamosal, while in reptiles it is more lateral and below the squamosal. It is probable that the reptilian notch developed independently in several groups from primitive captorhinomorphs, which have no notch—thus Sauropsida would have no phylogenetic meaning. vonHuene follows a pattern close to that currently accepted for higher reptiles, but deviates in division of amphibians and in including ichthyosaurs among the amphibian "Batrachomorpha."—VMJ

05161 **Rona, Peter A.; Schneider, Eric D.; Heezen, Bruce C.** Bathymetry of the continental rise off Cape Hatteras: Deep-Sea Research, v. 14, no. 5, p. 625–633, illus., tables, 1967.

The principal morphologic features of the continental rise off Cape Hatteras are Hatteras Outer Ridge and Hatteras Transverse Canyon, which trend parallel to regional isobaths, and the Hatteras and Pamlico canyons, which trend perpendicular to regional isobaths. Continuous geostrophic contour currents have shaped the Hatteras Outer Ridge while episodic turbidity currents have contributed to the development of the submarine canyons.—Authors' abstract

05243 **Rosenshein, Joseph Samuel.** Geohydrology of Pleistocene deposits and sustained yield of principal Pleistocene aquifer, Lake County, Indiana [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1584B, 1967.

04902 **Ross, Charles A.** Development of fusulinid (Foraminiferida) faunal realms: Jour. Paleontology, v. 41, no. 6, p. 1341–1354, illus., 1967.

More than 100 genera of fusulinids are distributed in the late Paleozoic geosynclines and adjacent marine shelves of Eurasia and the Western Hemisphere. Geographic distribution of these genera is uneven and forms the basis for recognizing 14 fusulinid faunal associations or subassociations which can be grouped into four faunal realms.—*from* Author's abstract

05303 **Ross, Reuben James, Jr.** *Anomalograptus* from the Seward Peninsula, Alaska: Jour. Paleontology, v. 41, no. 5, p. 1276–1278, illus., 1967.

Anomalograptus, a genus previously reported from Levis, Quebec, is represented by a different species in correlative Ordovician strata (zone of *Paraglossograptus etheridgei*) in the York Mountains, Seward Peninsula, Alaska.—Author's abstract

05093 **Rostad, O. H.** Geochemical case history at the Little Falls molybdenite prospect, Boise County, Idaho, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 249–252, illus., 1967.

The geology and mineralogy of the Little Falls molybdenite prospect is described briefly. A molybdenum soil anomaly map shows that soil in the central area contains about 2.5 times as much molybdenum, or over 320 ppm, as is present in the underlying bedrock. Stream sediment and water samples from the area were analyzed, but most failed to show any molybdenum content.—MST

Roth, J. N. *See* Callison, J. C. 04978

05351 **Rouse, G. E.** A Late Cretaceous plant assemblage from east-central British Columbia—[Pt.] 1, Fossil leaves: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1185–1197, illus., table, 1967.

About 45 species of leaves, spores, and pollen were collected from fine silts and coal stringers in the Parsnip River valley. The leaf assemblage is late Maestrichtian to Danian in age, somewhat younger than generally comparable assemblages previously reported from the lower Edmonton Formation of Alberta, and from the Hell Creek, Lance, and Fox Hills Formations of the United States. It also contains several species reported from the Nanaimo Group on eastern Vancouver Island. Plant microfossils include species of *Glyptostrobus, Sciadopitys, Aquilapollenites, Pistillipollenites, Alnus, Myrica, Tilia, Pterocarya*, and *Carya*. The assemblages indicate a warm mesothermal and humid paleoecological setting of low relief,

suggesting absence of major mountain ranges westward to the Pacific Ocean.—*from* Author's abstract

Rowe, M. W. *See* Funk, H. 05379

Rowe, M. W. *See* Clark, R. S. 05421

Roy, J. L. *See* Deutsch, E. R. 05343

05358 **Różkowski, A.** The origin of hydrochemical patterns in hummocky moraine: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1065–1092, illus., tables, 1967.

A small basin and hummock near Moose Mountain, Saskatchewan, are described. A Teledeltos model of the till areas shows the typical pattern of ground-water flow. Hydrochemical patterns develop from the variable chemistry of the till and from the ground-water movement. Three zones, SO_4–Mg–Ca in the recharge and transmission zones, and SO_4–Mg–(Na) in the discharge area are recognized. The increase in salinity from recharge to discharge is due to evapotranspiration and poor permeability. The SO_4–Mg–Ca recharge water forms in the aeration zone and changes occur in the zone of saturation by enrichment of easily-soluble salts and precipitation of poorly soluble salts. The former takes place in the shallow zone of discharge near the surface. The hydrochemistry of the sloughs is primarily determined by the chemistry of the incoming ground water.—*from* Author's abstract

Rubright, R. D. *See* Stacey, J. S. 05311

04889 **Runge, R. J.; Powell, N. J.** The effect of sampling rate on sonic log span adjustment, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. D1–D19, illus., 1967.

Sonic log span adjustment is achieved by using modern filter theory in which a filter, called a converter, is obtained via least mean squares deconvolution. This converter when convolved with one sonic tool vertical response produces another desired sonic tool vertical response of different span. The convolution is performed on digitized sonic logs using a high speed computer. The quality of the span adjusted sonic log, computed via such a procedure, depends on the ratio of the length of the sampling interval to the length of the desired final span. A low ratio tends to produce better quality results than a high ratio. The types of error and sensitivity of these results to the size of the sampling interval are discussed.—*from* Authors' abstract

05369 **Rush, F. Eugene.** Water-resources appraisal of Washoe Valley, Nevada: Nevada Dept. Conserv. and Nat. Resources, Water Resources—Reconn. Ser. Rept. 41, 39 p., illus., tables, 1967.

About 270,000 acre-feet of ground water is stored in the upper 100 feet of saturated valley fill in the Washoe Valley and about 20,000 acre-feet in Washoe and Little Washoe Lakes. Total estimated average annual inflow to the basin is 33,000 acre-feet. Estimated average annual outflow is 31,000 acre-feet, with evaporation from the lakes accounting for about 14,000 of this total. Water in the valley is generally suitable for irrigation, domestic, and stock uses. Ground water is hard on the east side of the valley and generally soft to moderately hard on the west side. Yield of the system is estimated between 15,000–25,000 acre-feet per year, depending upon how the water resources are developed. If the area becomes urbanized as the Reno-Carson City population grows, there is need for scientific water management.—*from* Author's abstract

05187 **Russell, Dale A.** A census of dinosaur specimens collected in western Canada: Canada Natl. Mus. Nat. History Paper 36, 13 p., illus., 1967.

Eleven locations in Alberta and Saskatchewan are considered; these are historically more important, and all are Late Cretaceous. Specimen lists are based on this census, although qualifications for clarity of faunal composition are given. *Parasaurolophus and Styracosaurus* are rare in the Red Deer River area, and *Monoclonius* (s. str.) is recorded for the first time; these are typical Oldman (Belly

River) forms. Faunas of Lancian age are dominated by *Triceratops*, although *Anatosaurus* increases in relative abundance from Alberta to Wyoming. In general the Lancian fauna has a uniform composition with some Alberta provincialism. There is no evidence to support reduction in diversity of dinosaur fauna prior to extinction at the end of Lancian time.—*from* Author's summary

05216 **Russell, Dale A.; Chamney, T. Potter.** Notes on the biostratigraphy of dinosaurian and microfossil faunas in the Edmonton Formation (Cretaceous), Alberta: Canada Natl. Mus. Nat. History Paper 35, 22 p., illus., 1967.

The occurrence of distinct vertebrate and microfossil assemblages in the Red Deer Valley are described. The lower member is essentially a symmetrical sequence of sedimentary facies bounded above and below by marine shale. Beach sands at the base are overlain by brackish-water coal-bearing deposits and then by fresh-water siltstone and shale; this sequence is then reversed, though the upper cyclic units are thinner. Foraminifera occur in all beds but fresh-water deposits; they are listed. *Edmontosaurus* occurs only in the lower coal-bearing unit, and *Cheneosaurus, Hypacrosaurus, and Saurolophus* occur in the central fresh-water facies. *Anchiceratops* occurs with both hadrosaurian faunas. Various nomenclatural changes are recommended, and reconstructions of skulls are made.—*from* Authors' summary

05385 **Russell, Dale A.** Systematics and morphology of American mosasaurs (Reptilia, Sauria) [with French and Russian abs.]: Yale Univ. Peabody Mus. Nat. History Bull. 23, 240 p., illus., tables, 1967.

Mosasauridae were large marine platynotan lizards which became abundant and diversified during Late Cretaceous time but disappeared at the close of the period. The family is divided into subfamilies Mosasaurinae (here subdivided into three new tribes), Plioplatecarpinae (two new tribes), and Tylosaurinae. Diagnoses and descriptions of 13 genera and 30 species from the Cretaceous of North America are presented, including a new genus, *Ectenosaurus* (type species *Platecarpus clidastoides* Merriam, Niobrara Formation, Kans.) and a new species, *Plioplatecarpus primaevus*, lower Pierre Shale, S. Dak. Osteology is described in detail and with reference to the soft anatomy. Paleoecology and faunal successions are considered in the light of stratigraphic information; all known occurrences are listed. Phylogeny and evolutionary trends are discussed.—VMJ

04909 **Russell, Loris S.** A pedunculate cirripede from Upper Cretaceous rocks of Saskatchewan: Jour. Paleontology, v. 41, no. 6, p. 1544–1547, illus., 1967.

Calantica? saskatchewanensis, a new species of pedunculate cirripede, is described from the Cretaceous Bearpaw Formation of Saskatchewan. The plates of this species are unusual and reference to *Calantica* is provisional; the plates may represent a new genus.—JP

05332 **Russell, Richard J.** Aspects of coastal morphology: Geog. Annaler, v. 49A, nos. 2–4, p. 299–309, 1967.

Much of the literature on coastal morphology has been concerned with classification of types of coasts. It is suggested here that when a valuable scheme of classification evolves, its primary distinctions will depend on lithologic contrasts. Changes of level during Cenozoic, different types of flats, and selected topics in beach morphology are discussed. Cliffy coasts should be interpreted as products of events during low stands; many were drowned during the last rise. Maximum development of estuaries occurred during Quaternary high stands, as at present. Delta stream patterns differ from those of flood plains in origin and appearance.—ESL

05348 **Rutherford, G. K.** A preliminary study of the composition of precipitation in S.E. Ontario: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1151–1160, illus., tables, 1967.

Analyses of bulk rainfall and snowfall are presented and compared with those from other areas. The Si and Al are high; in snow, Si is absent and Al is very high. Areal differences in Si are related to lithology. Iron is similar to Al and is due

to atmospheric dust. Sodium is high, especially compared with other inland sites. Potassium is generally somewhat lower than sodium. Calcium reflects local lithology, but Mg is very uniform. Nitrate-N concentrations are high in the limestone area. Snowfall is markedly high in sulfates, which are considered to be a function of climatic and industrial causes. The high chloride content in an inland environment is not explained.—*from* Author's abstract

05007 **Saint-Onge, Denis.** La vallée de l'Athabasca, entre Eindfall et Chisolm, Alberta [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, p. 100-101, 1967.

05019 **Saint-Onge, Denis.** Les "Humpies" de la région de Whitecourt, Alberta [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 99, 1967.

04911 **Sanderson, G. A.** A bibliography of the family Fusulinidae, addendum 5: Jour. Paleontology, v. 41, no. 6, p. 1564-1568, 1967.

Addendum 5 comprises 125 references concerning the family Fusulinidae, bringing the cumulative total to 1,860. A significant number of older publications is included in this addendum, 20 percent dating from 1959 or before. Nevertheless, the majority of entries are from this decade, and 32 percent of the total was published in 1966 or 1967.—Author's introduction

04993 **Sauvé, Pierre.** Différentiation d'un filon-couche de gabbro anorthositique [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965-66, v. 33, p. 91-92, 1967.

05119 **Scharff, Robert.** (editor). Glacier National Park and Waterton Lakes National Park: New York, David McKay Co., 184 p., illus., 1967.

The review of the geologic history of the Parks (Chap. 2) describes deposition in the early sea; later folding and overthrusting, with a description of the Lewis overthrust; uplift and dissection by streams; and glaciation with its resulting features. The sedimentary formations of the Precambrian Belt Series in the area, the metagabbro sill, and Purcell lava are described, as are several of the 50 or 60 glaciers.—ESL

05432 **Scharff, Robert.** (editor). Yellowstone and Grand Teton National Parks: New York, David McKay Co., 209 p., illus., 1967.

The geological history of the Yellowstone area is reviewed in chapter 2: deposition of sediments; folding and buckling of the crust; volcanism, with forests growing between eruptions; fissure lava flows; development of hot springs and geysers, becoming localized along the larger fissures; basalt flows; and uplift followed by glaciation. Hot springs, pools, geysers, fumaroles, mud springs, and the formation of travertine and geyserite are described and the mechanics explained. The valleys of Yellowstone can be placed in two classifications, open valleys and canyons. A section of chapter 4 tells of the fault origin of the Tetons, ice sculpturing of valleys, and formation of lakes by moraine damming. Granite with diorite veins forms most of the mountains.—ESL

05084 **Schirner, Silas W.** New directions in earth science in Iowa schools: Iowa Acad. Sci. Proc. 1965, v. 72, p. 404-412, illus., tables, 1967.

Earth science dropped from about 30 percent to .4 percent of the total school enrollment from 1900 to 1949; its decline was paralleled by an increased offering of biology. In the modern high school curricula it is replacing general science, mostly at the ninth grade level; offerings are on the increase in Iowa from seven districts in 1960 to 53 in 1965, an increase of 757 percent, which is roughly 10 percent of the schools. Most states have no certification requirements for earth science teachers who are certified under general science or science in general; there are not enough qualified teachers at present.—*from* Author's abstract

04991 **Schmidt, A. W.; Tinch, D. H.; Carpenter, B.; Hoyle, W. R.** Computerized log analysis for efficiently evaluating gas wells and gas storage reservoirs, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. S1-S23, illus., table, 1967.

Open-hole log interpretation methods are employed to provide effective porosity data which is then used with cased-hole neutron logs to compute gas saturations in storage reservoirs. A method of using density and neutron logs to solve the problem of porosity determination in shallowly invaded gas reservoirs is developed. A system of digital magnetic tape and a computer was used to process the large amounts of log data. Line printer frequency plots and customized "Computed Logs" are graphical techniques developed to display the computer output in analyzable form. The computed logs were employed in the construction of cross-sections as well as porosity and hydrocarbon fraction maps. The computer was used to integrate these maps into total reservoir and gas storage volumes.—Authors' abstract

05410 **Schmitt, R. A.; Smith, R. H.; Ehmann, William D.; McKown, D.** Silicon abundances in meteoritic chondrules, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 1975–1985, tables, 1967.

Silicon abundances have been determined in some 275 chondrules (masses ranging from 0.1 to 70 mg) from 19 different chondrites from most chondritic groups by instrumental, 14-MeV neutron activation analysis. Average Si abundances at about 20 percent in chondrules from Type II carbonaceous chondrites agreed well with a forsterite composition for these chondrules. In general, ca. 25 percent more Si is present in chondrules than in the bulk chondrites. Very low Si abundances (0.6 to 2.5 percent) have been observed in some Al Rais, Renazzo, and Tennasilm chondrules. This hiatus in Si abundances of about 2 percent and 20 percent suggests that meteoritic chondrules may have originated from two different sources in the solar nebula or from the same nebular source but under changing temperature-pressure conditions.—*from* Authors' abstract

Schneider, Eric D. *See* Rona, Peter A. 05161

05425 **Schneider, Eric D.; Fox, Paul J.; Hollister, Charles D.; Needham, H. David; Heezen, Bruce C.** Further evidence of contour currents in the western North Atlantic: Earth and Planetary Sci. Letters, v. 2, no. 4, p. 351–359, illus., 1967.

Compass-oriented sea-floor photographs, echograms, and sediment cores on the Atlantic continental margin of North America have been studied to evaluate the role of deep-sea contour currents in shaping the continental rise. Below an abrupt change in regional slope a swift bottom current is observed which flows southwest parallel to the contours; further downslope currents are variable in direction and weaker; and northerly directions indicate the Gulf Stream may intermittently scour the sea floor. Hyperbolic echo traces, prolonged multiple echo sequences, and wedging of subbottom reflecting interfaces can be mapped as distinct zones of sea floor micromorphology which parallel regional contours of the continental rise. The continental rise is a large sediment wedge which owes its shape to deep geostrophic contour currents.—*from* Authors' abstract

Schneider, William J. *See* Stuart, Wilbur T. 05290

05066 **Scholl, David W.; Stuiver, Minze.** Recent submergence of southern Florida—Reply [to discussion of 1967 paper by W. G. Smith and J. M. Coleman]: Geol. Soc. America Bull., v. 78, no. 9, p. 1195–1198, 1967.

Discussion of the Florida findings by W. G. Smith and J. M. Coleman (ibid., p. 1191–1194) indicates the scope of the present controversy concerning eustatic positions of the sea level during the last 3,000–4,000 years. In reply to their comments, the authors make it clear that the transgressive record preserved in the coastal sediments of southern Florida has been recognized independently by several other investigators. In addition, a recently completed series of new C-14 age determinations to evaluate sedimentation rates of fresh-water calcitic mud has substantiated their Florida submergence curve.—CCC

Scholten, Robert. *See* Beutner, Edward C. 04968

05438 **Schou, Axel.** Pecan Island—A chenier ridge in the Mississippi marginal delta plain [with German abs.]: Geog. Annaler, v. 49A, nos. 2–4, p. 321–326, illus., 1967.

The Mississippi delta is a complex consisting of the recent bird-foot delta and several fossil deltas now modified by the isostatic downwarping of this region on the edge of the active Gulf geosyncline. Chenier islands are stranded sand beaches in a marshland environment; initially formed along the shore, they indicate former coast lines. On the chenier plains of southwestern Louisiana, hurricanes have significant geomorphic effect. The interplay between chenier formation and delta development is discussed, based on the results of Richard J. Russell's research work. The description utilizes the author's observations from field trips in 1959 and 1963.—*from* Author's abstract

05117 **Schuberth, Christopher J.** The Hudson's six geologies: Nat. History, v. 76, no. 1, p. 46–55, illus., 1967.

Few rivers in North America traverse terrane of such geologic diversity as does the Hudson. Its source is in the Adirondack Mountains where it flows over Precambrian shield rocks. At Glens Falls, the river goes into the Folded Appalachians, and is narrower here than farther south. Becoming an estuary, the Hudson flows past the Catskills, revealing Devonian delta-type deposits. In the Hudson Highlands, the river traverses low ranges of Precambrian rock cut by Storm King Granite, and flows between the metamorphic New England Upland and Triassic New Jersey Lowland. Pegmatite minerals of the former and use of the latter for construction are described; mineralogy and structure of the Palisades diabase are discussed. The Hudson breaches the terminal moraine at the Narrows and joins the East River.—ESL

05360 **Schwarz, E. J.** Thermomagnetic analysis and ore genesis: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1119–1125, illus., 1967.

The potential of rock magnetism in studies on the genesis of ore deposits is examined. It is suggested that techniques based on magnetic properties other than the direction of the stable part of the natural remanent magnetization might prove usefully applicable. More specifically the analysis of the type of remanent magnetization in ores and their wall rocks is suggested as a worthwhile approach in the study of ore genesis. Other methods suggested are based on the occurrence of chemical or physical changes affecting ferromagnetic minerals in ores during heating. It may be possible to relate the results of such experiments to the thermal conditions prevailing at the time of either formation of minerals in ore deposits or acquisition of stable remanent magnetization.—Author's abstract

05353 **Schwerdtner, W. M.; Clark, A. R.** Structural analysis of Mokka Fiord and South Fiord Domes, Axel Heiberg Island, Canadian Arctic: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1229–1245, illus., 1967.

The exposed cores of these structures are composed chiefly of Pennsylvanian anhydrite, and are surrounded by Mesozoic rocks. A geometric analysis of two well-exposed domes was made to learn whether the anhydrite behaved as an active source material or as a passive overburden during doming. Attitudes of bedding and lenticular limestone boudins were measured in both, and axial traces of macroscopic folds were constructed. The flow pattern in the cores corresponds to that predicted by model studies, suggesting that layered anhydrite behaved essentially as a source material for the domes. During late stages of doming, large radial fractures developed in upper levels of the anhydrite cores.—*from* Authors' abstract

05079 **Sendlein, Lyle V. A.** Detailed mapping of the bedrock configuration in Des Moines County, Iowa, with an electrical resistivity instrument: Iowa Acad. Sci. Proc. 1965, v. 72, p. 316–323, illus., 1967.

A Gish–Rooney type earth resistivity apparatus was used to obtain depth to bedrock at 110 instrument locations in north-central Des Moines County, Iowa. The variable depth method was employed in an area where some borehole information was already available. The features on the resultant bedrock configuration map are more clearly defined than those on a map produced from borehole data only. The resultant map is considered to be more reliable. The reliability of the method depends on the geologic conditions and the amount of data available prior to the study.—Author's abstract

Shaw, Charles E., Jr. *See* Petersen, Richard G. 05292

Shaw, D. M. *See* Payne, J. G. 05336

Shaw, D. M. *See* Reilly, G. A. 05347

Shaw, Frederick C. *See* Brophy, Gerald P. 04898

04904 **Shaw, Nolan G.** Cheilostomata from Gulfian (Upper Cretaceous) rocks of southwestern Arkansas: Jour. Paleontology, v. 41, no. 6, p. 1393–1432, illus., 1967.

Cheilostome Bryozoa, collected by detailed sampling in Gulfian (Upper Cretaceous) rocks in southwestern Arkansas, were studied taxonomically and compared with their counterparts from other North American and European strata of Cretaceous and Paleocene age. Many specimens, most of them poorly preserved, were found randomly distributed through the Brownstown, Ozan, Saratoga, and Nacatoch formations, and most abundantly in biostromal pelecypod accumulations. The abundant occurrences apparently represent shoalwater habitats, and most of the specimens incrust pelecypod valves. The Arkansas occurrences represent the Santonian to upper Maastrichtian European stages. The concurrence of ranges of similar species on the two sides of the Atlantic is striking.—*from* Author's abstract

05278 **Shelton, John W.** Stratigraphic models and general criteria for recognition of alluvial, barrier-bar, and turbidity-current sand deposits: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2441–2461, illus., table, 1967.

The depositional framework for sandstone bodies is most accurately determined by comparing their geometry and internal features with those of sand units of known depositional environments. The Cretaceous Cut Bank Sandstone in northwestern Montana is an example of alluvial valley deposition; the basal and lateral contacts are sharp erosional boundaries and the grain size decreases upward. The lowermost unit of the Cretaceous Eagle Sandstone at Billings, Mont., was deposited as a barrier-bar; the lower and lateral contacts are gradational whereas the upper contact is sharp and the grain size increases upward. The Pliocene Repetto "Formation" of the Los Angeles basin includes a great thickness of turbidity-current sandstone, deposited in a deep-marine orogenic basin; each unit is composed of several graded sandstone beds with sharp basal contacts.—EAM

05376 **Sherif, M. A.; Chen, J. T.** Application of the finite-element method to stress distribution in soil media: Trend Eng., v. 19, no. 4, p. 27–29, illus., 1967.

Since the formations of the earth masses are usually nonhomogeneous nonelastic, anisotropic, and arbitrary in configuration, the stress distribution within the soil cannot be adequately determined by classical analytical theories. The newly developed finite-element method of analysis is presented for determining the alteration of an existing stress pattern in soils due to excavation and loading. The stress distributions in a retained cut for various boundary conditions are presented herein.—Authors' abstract

05254 **Shlemon, Roy James.** Landform-soil relationships in northern Sacramento County, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1570B, 1967.

05151 **Shor, G. G., Jr.** Explosion seismology at sea, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 415–420, 1967.

Seismic refraction work at sea by American institutions since 1963 is summarized, with an extensive bibliography. Because of the long time required to reduce refraction data, much work done since 1963 is not yet published. The most noticeable change in refraction work has been the increasing detail with which the profiles have been shot, and higher density of lines to detect structural and velocity changes over short distances on the sea floor. Preliminary results of detailed surveys using circles of shots and lines of shots in various azimuths suggest that the anisotropy of mantle velocity is real.—DBV

Short, James M. *See* Goldstein, Joseph I. 05429

Shrewsbury, R. D. *See* Moore, B. J. 05437

05106 **Siems, P. L.** Geochemistry in the Selway–Bitterroot Wilderness area, central Idaho [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 274–275, 1967.

Silver, Leon T. *See* Duke, Michael B. 05414

05394 **Silverman, Daniel.** The digital processing of seismic data: Geophysics, v. 32, no. 6, p. 988–1002, illus., 1967.

The paper discusses the background of the problem of signal and noise in the seismic process, and application of principles of communication theory. Limitations of the process are discussed along with types of noises involved, methods of rejecting noise, use of filters to reduce noise, characteristics of filters, and relations between frequency domain, time domain, mathematical, and digital filters. In discussion of electronic data processing of seismic information, characteristics of an ideal seismic digital computer system are developed in relation to characteristics of seismic data. The choice between digital and analog field recording is discussed in relation to needs of the seismic process and quality of data. Among mathematical processes discussed are velocity filtering and types of Wiener filtering, including horizontal stacking, deghosting, deconvolution, and multitrace digital filtering.—*from* Author's abstract

05374 **Simmons, George C.** Geologic map of the Palmer quadrangle, east–central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–613, scale 1:24,000, sections, text, 1967.

Gas is produced from Lower(?) Ordovician sandstone on the Mina dome; structure contours indicate the dome has from 45 to 70 feet of closure. Residual and alluvial clays are abundant. Shale of the Crab Orchard Formation weathers readily to a very plastic clay that slumps when moist; therefore, construction on the Crab Orchard should have suitable foundation and drainage, or the clay should be removed. Potable water is obtainable from springs and wells in all formations except the Borden and Crab Orchard.—MCM

05316 **Simpson, John F.** Earth tides as a triggering mechanism for earthquakes: Earth and Planetary Sci. Letters, v. 2, no. 5, p. 473–478, illus., 1967.

On the basis of the congruence of the actual distribution and the theoretical random distributions of 22,561 earthquakes which occurred between 1 January 1950 and 30 June 1963 it is concluded that earthquakes are not triggered by specific amplitudes of acceleration of earth tide component forces.—Author's abstract

05107 **Sims, W. A.** Heavy minerals as prospecting guides, Gaspé, P. Q. [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 275, 1967.

05295 **Sinclair, S. R.; Brooker, E. W.** The shear strength of Edmonton shale [with French abs.], *in* On shear strength properties of natural soils and rocks—Geotech. Conf., Oslo, 1967, Proc.: Oslo, Norway, Norwegian Geotech. Inst., p. 295–299, illus., table, 1967.

The shear strength properties of several late Cretaceous bedrock materials [Edmonton shale, Alberta] have been determined by both triaxial and direct shear test methods. The materials were divided into three main rock types—clay shale, bentonitic shale, and bentonite, depending upon plasticity. Triaxial test results at effective consolidation pressures as high as 500 psi were reported for all three materials. The effective stress rupture lines were found to be roughly parallel and of concave downwards shape with a final inclination of only 8 1/2 degrees at the higher pressures. The triaxial tests gave peak strengths only. Direct shear tests yielded both peak and residual strengths. The residual strengths have proven valuable in analyzing the stability of several shale slopes.—Authors' summary

05142 **Slichter, Louis B.** Earth tides, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 355–357, 1967.

Since 1963 earth-tide investigations have been conducted or are being initiated by 12 institutions in the United States. The instrumentation of these stations is described briefly, and a bibliography of pertinent works is given.—DBV

05260 **Slichter, Louis B.** Spherical oscillations of the Earth, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 171–176, illus., tables, 1967.

Frequencies of spheroidal free oscillations observed at Los Angeles due to the 1964 Alaska earthquake are listed. For the lower-degree modes the values are generally an order of magnitude more precise than those customarily reported. Several circumstances which contribute to this precision are discussed. Some of the overtones are also listed. In the case of ${}_0S_0$ and ${}_0S_2$ the precision seems to be especially high, with the several determinations differing respectively by 3 in 100,000 and 1.5 in 10,000. The mode ${}_0S_0$ and its first overtone, S_0, are well observed. Q-values for some of the observed spheroidal modes are also presented.—*from* Author's abstract

00027 **Smedley, Jack E.** Summary report on the geology and mineral resources of the Okefenokee National Wildlife Refuge, Georgia: U.S. Geol. Survey Bull. 1260-N, p. N1–N10, illus., table, 1968.

The Okefenokee National Wildlife Refuge includes approximately 323,000 acres of Okefenokee Swamp and 9,000 acres of adjacent uplands. The swamp, in a broad basin on the Atlantic Coastal Plain, is bounded on the east by a large sand ridge (Trail Ridge), and drained by the Suwannee and St. Marys Rivers. Surface formations consist of unconsolidated Pleistocene and Recent sediments; marine rocks of Paleozoic(?), Cretaceous, Paleocene, Eocene, Miocene, and Pliocene ages occur in the subsurface. No minerals have been mined; test wells for oil and gas in adjacent areas have not resulted in commercial production. The swamp is filled with vast quantities of peat, but attempts to mine it were economically unsuccessful. Pleistocene sands and Tertiary rocks underlying the swamp peat deposits presumably contain phosphate, but these deposits would be covered by 40–110 feet of water, peat, and other overburden.—*from* Author's abstract

05440 **Smith, Howard E., Jr.** From under the earth—America's metals, fuels, and minerals: New York, Harcourt, Brace and World, Inc., 161 p., illus., table, 1967.

A chapter is devoted to each of 28 economic products, and includes history, description, refining, and uses, as well as origin, properties and occurrence.—ESL

Smith, J. L. *See* Albee, A. L. 05196

05108 **Smith, J. R.** Detection of anomalous concentrations of ore metals in Precambrian country rock [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 275–276, 1967.

05428 **Smith, Peter J.** Ancient geomagnetic field intensities from igneous rocks: Earth and Planetary Sci. Letters, v. 2, no. 4, p. 329–330, illus., table, 1967.

In studies of magnetic, chemical, and petrographic properties of a lava flow investigated previously by Smith (1967), Wilson, Haggerty, and Watkins (1967) have developed a titanomagnetite classification scheme in which grains are placed in 1 of 6 classes corresponding to progressive oxidation states; 300 grains were classified and given a mean overall oxidation parameter, M; values of M are given here in a table for eight specimens upon which ancient field intensity determinations have been made. Correlation between apparent field intensity and M, and the limited range of M over which reliable field intensities were obtained are presented without explanation. If reliable ancient field intensities are always obtained from specimens

within this limited range, *M* measurement might be an accurate means of selecting specimens suitable for field intensity measurements.—VSN

05436 **Smith, Peter J.** Ancient geomagnetic field intensities—[Pt.] 2, Geological data, sets G1–G21; historic and archeological data, H10–H13: Royal Astron. Soc. Geophys. Jour., v. 13, no. 5, p. 483–486, 1967.

The accompanying tables contain all geological field intensity data known to the author in June 1967 together with additional historic and archeomagnetic data made available since the previous list was prepared (Smith 1967). As before, historic and archeological time has been defined as the past 10,000 years.—Author's summary

Smith, R. H. *See* Schmitt, R. A. 05410

05149 **Smith, Stewart W.** Free oscillation analysis and interpretation, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 409–412, 1967.

In 1963–67, research in the free oscillations of the Earth has been focused on (1) refinement of the observed frequencies of oscillations and attenuation of coefficients; and (2) development of inversion techniques to use these data to improve the elastic, anelastic, and density structure for the Earth. Progress in data refinement, interpretation, analysis, energy calculations, and instruments is reviewed briefly, and gaps in the experimental data are pointed out. A bibliography of pertinent works is given.—DBV

05067 **Smith, W. G.; Coleman, J. M.** Recent submergence of southern Florida—Discussion [of paper by D. W. Scholl and M. Stuiver, 1967]: Geol. Soc. America Bull., v. 78, no. 9, p. 1191–1194, 1967.

Many of the dated samples reported by Scholl and Stuiver [ibid., v. 78, p. 437–454, 1967] probably cannot be as closely related to past sea level as their small margins of error would suggest. More evidence of the true nature of the materials dated and the environments in which they accumulated must be provided. In the low-relief area of the Everglades and adjacent swamps, the materials used probably generally reflect the last phase of sea-level rise. More precise determinations seem necessary, however, before acceptance of the area as a standard of comparison for other coasts.—Authors' abstract

05189 **Smoor, Peter Bernard.** Hydrochemical facies study of ground water in the Tucson Basin [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1602B, 1967.

Snavely, Parke D., Jr. *See* Weissenborn, A. E. 00011

Snavely, Parke D., Jr. *See* Weissenborn, A. E. 00020

Snavely, Parke D., Jr. *See* Weissenborn, A. E. 00021

Snavely, Parke D., Jr. *See* Peterman, Zell E. 05314

05131 **Snowden, Dervorguilla.** 1966–1967 index of publications of the Geological Survey of Canada: Canada Geol. Survey Paper 67-3, 57 p., 1967.

This index, a continuation of Paper 66-3(Mahoney, 1966), lists memoirs, bulletins, economic geology reports, papers, miscellaneous reports, indexes, catalogs, geologic maps, preliminary series maps, and aeromagnetic series maps published since March 1967. Publications are grouped geographically also, and there is an author index.—MCM

05073 **Spain, Donald F.** Fossiliferous plants of the Pennsylvanian period from a selected area in Macon County, Missouri: Iowa Acad. Sci. Proc. 1965, v. 72, p. 106–113, illus., 1967.

Macro-fossil specimens were collected from eight evenly spaced locations along the face of a 150-ft shale exposure. The exposure was located along Sand Creek

northeast of Elmer, Missouri, in Macon County. The fossils were all of plant life and consisted mostly of compressions of plant fragments, some plant impressions, mineral replacements, and casts. Specimens of *Pecopteris, Neuropteris, Alethopteris,* unidentifiable fern types, miscellaneous fern particles, *Calamites, Sphenophyllum, Sigillaria, Cordiates, Ginkgo, Stigmaria,* and two unknown Carpi were found.—*from* Author's abstract

04971 **Sparling, Dale R.** Anomalous drainage patterns and crustal tilting in Ottawa County and vicinity, Ohio: Ohio Jour. Sci., v. 67, no. 6, p. 378–381, illus., 1967.

The area is on a flat glacial lake plain west of Lake Erie. The drainage pattern on the lake plain is anomalous in that the streams do not trend directly down the present slope normal to the strike. The region has experienced tilting down toward the north about an east–west trending axis, producing an increased gradient to the north and resulting in much piracy. The tilting is calculated at 2.8 feet per mile and is believed to be related to isostatic adjustment during and following the last stages of Pleistocene glaciation.—*from* Author's abstract

05051 **Spencer, Alexander B.; Clabaugh, Patricia S.** Computer program for fabric diagrams: Am. Jour. Sci., v. 265, no. 2, p. 166–172, illus., 1967.

A computer program has been devised that can take any number of data representing, by azimuth and plunge angles, the orientations of lines in space and print out an array of density values equivalent to a percent analysis of points on a Schmidt equal-area net. The output can be assembled and contoured in a few minutes, and the result is a precise contour diagram such as those conventionally prepared to analyze mineral orientations, joint planes, fold axes, et cetera. The program is written in Fortran 63 language to run under the Co-op Monitor System on a CDC 1604 computer but can easily be adapted for use with other systems. The availability of a computer program to aid in processing orientation data may well encourage more frequent use of fabric diagrams in the analysis of petrologic and structural geologic problems.—Authors' abstract

05311 **Stacey, J. S.; Moore, W. J.; Rubright, R. D.** Precision measurement of lead isotopes ratios—Preliminary analyses from the U.S. Mine, Bingham Canyon, Utah: Earth and Planetary Sci. Letters, v. 2, no. 5, p. 489–499, illus., tables, 1967.

A gas-source mass spectrometer has been constructed for precise measurement of lead isotope ratios. Sixteen analyses on 4 different preparations of the same galena made over a period of 2 months gave 95 percent confidence limits (per analysis) of Pb-206/Pb-204 = 0.080 percent, Pb-207/Pb-206 = 0.042 percent and Pb-208/Pb-206 = 0.046 percent. Eight samples from the U.S. mine in the Bingham district have a linear relationship over the 1 percent range of their Pb-206/Pb-204 ratios. The simplest model fitting these data suggests that lead was separated from a primary system ($\mu = 8.98$) 1630 ± 150 m.y. ago and subsequently mixed with a radiogenic lead of similar age; biotite K-Ar dates for altered intrusive rocks associated with the ores provide an apparent age of mineralization and suggest that isotopic evolution of the lead was terminated about 36 m.y. ago.—Authors' abstract

Stanley, Daniel J. *See* Gross, M. Grant. 00006

04934 **Stanley, Rolfe S.** Geometry and age relations of some minor folds and their relation to the Woronoco nappe, Blandford and Woronoco quadrangles, *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercoll. Geol. Conf., 59th Ann. Mtg., Amherst, 1967: [New Haven, Conn., Yale Univ. Dept. Geology] p. 48–60, 1967.

The geology of the Blandford-Woronoco area is dominated by the complexly deformed Woronoco nappe, which is draped over the northern part of the Granby dome. Current mapping of this area shows that the stratigraphic units (Cambrian–Devonian) do not conform to B. K. Emerson's interpretation (1898, 1917); the stratigraphy is summarized in tabular form, and the current map units, given only number-letter designation, are tentatively correlated with named units to the north (Hatch, 1967). Relationships of four generations of folds in superposition are tabulated and shown on orientation diagrams and axial surface maps. Excellent

outcrops along the shore of the Cobble Mountain Reservoir, showing superposed relationship of the folds, are described in the brief road log.—VMJ

05282 **Stanton, Robert J., Jr.** Factors controlling shape and internal facies distribution of organic carbonate buildups: Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2462–2467, illus., 1967.

Published descriptions of ancient and modern reefs have not been adequately and usefully synthesized. The primary factors which determine reservoir characteristics of individual carbonate buildups are three aspects of the physical environment: (1) directional features of the climate, particularly wind; (2) paleogeographic setting; and (3) local bathymetry. The external shape and internal facies arrangement of buildups is much less dependent on the variabls of geologic age and biota. Wind, through the generation of waves and currents, controls the organic carbonate productivity and, as a result, the extent and distribution of sediment production. The geographic setting and topography of the sea floor adjacent to the buildup determine the effectiveness of the directional aspects of the environment.—EAM

05145 **Stauder, William.** Earthquake mechanisms, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 395–400, 1967.

Three factors have contributed to significant advances in understanding of source mechanisms in the past few years: (1) steady development of the theory relating displacement fields of seismic body and surface waves to the parameters of the source and of the source motion; (2) an increased amount of available data for the application of theory to the determination of source parameters; and (3) intensive studies of certain individual earthquakes such as the Alaskan of March 1964 or the Parkfield (California) of June 1966. The double couple apparently is an adequate representation of the focal mechanism in most earthquakes; larger earthquakes are represented by a line formed by the propagation of such nuclei. Publications along these lines are discussed briefly and compiled in a bibliography.—DBV

04942 **Stearns, Richard G.** Warping of the Western Highland Rim peneplain in Tennessee by ground-water sapping: Geol. Soc. America Bull., v. 78, no. 9, p. 1111–1124, illus., 1967.

The Western Highland Rim physiographic province shows close similarity in the configuration of the upland, the structure of the base of the Cretaceous, and the erosional levels of graded streams. Two alternative explanations are likely: either (1) more recent steepsided valleys are incised in wide, gentle valleys cut before Middle Cretaceous by the same streams; or (2) the stream-flow system by ground-water sapping has caused the old upland to sag toward the incised streams. An unlikely third possibility is that the streams flow in synclines folded after the development of the upland. To compare upland levels, bottom land levels, and Cretaceous structure, the subenvelope [newly devised for this paper] and envelope, which are arbitrarily generalized contour maps, are used.—*from* Author's abstract

Stevens, R. P. *See* Murphy, James L. 04915

Stevenson, Robert E. *See* Cushman, George C. 05208

05134 **Stirton, R. A.** Relationships of the protoceratid artiodactyls, and description of a new genus: California Univ. Pubs. Geol. Sci., v. 72, 43 p., illus., table, 1967.

Lambdoceras hessei, n.gen. n.sp., of Protoceratidae (Tylopoda) is described from the Flint Hill fauna of South Dakota. It belongs to the early Hemmingfordian Mammalian Age, early middle Miocene, and is most closely related to *Syndyoceras* Scott and *Synthetoceras* Stirton. Foot bones indicate a habitus for running and jumping somewhat as in pigs and peccaries; there was more lateral flexibility than in Miocene camelids and ruminants. Maxillary rostral and postorbital horns were probably covered with tough skin as in giraffes. Citations and a brief review of known protoceratid genera are given. It is thought that the late Eocene *Leptotragulus* is ancestral to the family. The Leptotragulinae, except *Leptomeryx*, are preferably classified as a subfamily of the protoceratids.—*from* Author's abstract

05426 **Strangway, D. W.; McMahon, B. E.; Honea, R. M.; Larson, E. E.** Superparamagnetism in hematite: Earth and Planetary Sci. Letters, v. 2, no. 4, p. 367–371, illus., 1967.

It is well known that small particles of ferromagnetic material show superparamagnetic behavior. The magnetic properties of hematite, which has a weak spontaneous magnetization show superparamagnetic behavior in grains which are as large as 1/4 to 1/2 μ in diameter. This is shown to be the case by the use of magnetic tests, including hysteresis and Curie temperature effects and by the use of X-ray diffraction and optical determination of particle sizes.—Authors' abstract

05290 **Stuart, Wilbur T.; Schneider, William J.; Crooks, James W.** Swatara Creek basin of southeastern Pennsylvania—An evaluation of its hydrologic system: U.S. Geol. Survey Water-Supply Paper 1829, 79 p., illus., tables, geol. map, 1967.

Locally residents of the Swatara Creek basin find it necessary to store, transport, and treat water because local supplies are either deficient or have been contaminated by disposal of wastes in upstream areas. Except where polluted, most ground water is suitable for public and industrial uses without extensive treatment. Most wells yield water from the upper 350 feet of formations: >300 gpm in alluvial materials in valley bottoms and some limestones, 50–300 gpm in loosely cemented sandstones and fractured limestones, 10–50 gpm in shales and harder sandstones, 1–10 gpm from most dense rocks. This report aims to show the relationship of distribution and movement of water in such a manner that when modification of any part of the system is made, effects will be known in other areas. Providing water for dilution of wastes from treatment plants has not been a problem, but in the future amounts needed for this purpose will be greater as population increases.—MCM

Stuiver, Minze. *See* Scholl, David W. 05066

05247 **Sturgul, John Roman.** Effects of surface irregularities on the underground stress field [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1588B, 1967.

Suess, Erwin. *See* Chave, Keith E. 05388

05152 **Sutton, George H.** Special experiments in seismology, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 420–422, 1967.

The Large Aperture Seismic Array in eastern Montana is described briefly. A seismic refraction experiment is being designed for the Apollo lunar spacecraft. Seismic measurements on the ocean floor have continued since 1963 with increased emphasis on longer observation times. Interest in the problem of earthquake prediction is high. Coordinated programs of study have been initiated along the San Andreas fault system and elsewhere. Microearthquakes associated with active faulting, aftershock sequences, and volcanic activity are being studied using sensitive portable equipment. A bibliography of pertinent works is given.—DBV

04914 **Swain, Frederick M.; Bratt, Judy M.; Kirkwood, Samuel.** Carbohydrate components of some Paleozoic plant fossils: Jour. Paleontology, v. 41, no. 6, p. 1549–1554, tables, 1967.

Several species of Paleozoic plants were chemically analyzed for acid-extractable monosaccharides. Comparisons were made with modern plants, in order to establish possible relationships between carbohydrate components of fossil and living plants. General similarities were noted.—SHM

Swanson, Donald A. *See* Walker, George W. 00025

Swanson, Donald A. *See* Walker, George W. 00026

04941 **Swanson, Donald A.** Yakima Basalt of the Tieton River area, south-central Washington: Geol. Soc. America Bull., v. 78, no. 9, p. 1077–1109, illus., tables, 1967.

The upper Miocene–lower Pliocene pre–Vantage basalt flows are the lower part of the Yakima Basalt, which is, in turn, the upper part of the Columbia River Group. The pre–Vantage flows are tholeiitic basalt composed of about equal parts of plagioclase (An_{45} to An_{65}), and clinopyroxene, which seems to range continuously from augite to pigeonite ($2V_z = 45°$ to 0°), mixed with 10 to 77 percent glass ($\mu = 1.53$), and minor amounts of other minerals, including sparse olivine. Most of the flows are columnar, have smooth tops, and are without flow structures, which indicates that most flowage had ceased prior to crystallization. The flows dip homoclinally eastward off the Cascade Range, and before erosion extended west beyond their present limits. Direction of flow was from the southeast, counter to the present slope of the flows, indicating the Cascades have risen since the flows were emplaced.—WHN

05144 **Sykes, Lynn R.** Seismicity, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 389–395, 1967.

The years 1963–67 saw renewed American interest in seismicity. Topics of unusual interest included the great Alaska earthquake of March, 1964; the more than 1,000 earthquakes in the Denver area, caused or triggered by pumping of waste fluids into a deep disposal well; evidence supporting the hypothesis of transform faults and sea-floor spreading; seismicity of island arcs; accurate location of epicenters in California, Nevada, and Hawaii; delineation of a system of active ridges and fracture zones north of the Mendocino fracture zone in the northeast Pacific; and microearthquakes. Publications along these lines are mentioned and tabulated.—DBV

05349 **Symons, D. T. A.** Paleomagnetism of Precambrian rocks near Cobalt, Ontario: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1161–1169, illus., table, 1967.

A paleomagnetic study was made on 32 hand samples from Precambrian rock units in the Silverfields Mine, Cobalt, Ontario. The samples from the Keewatin lavas proved unsuitable for paleomagnetic study. The Cobalt Group sediments and Nipissing diabase sill have stable primary remanences, which yield pole positions of 82.5° E., 21.5° S. and 74.4° E., 11.9° N. respectively after alternating-field demagnetization. The upper slate member of the Cobalt Group is in contact with the sill and its primary remanence has been altered by contact metamorphism.—Author's abstract

Szekely, Thomas S. *See* Brophy, Gerald P. 04898

Talbot, J. L. *See* Raleigh, C. B. 05031

05412 **Tanner, James T.; Ehmann, William D.** The abundance of antimony in meteorites, tektites, and rocks by neutron activation analysis, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 2007–2026, illus., tables, 1967.

Antimony has been determined by neutron activation in 24 chondrites, 8 achondrites, 3 siderites, 5 separated meteoritic phases, 12 tektites, 6 natural glasses, 11 standard rocks, 15 selected terrestrial rocks, and 8 deep-sea sediments. The data confirm the expectation that antimony has appreciable siderophilic and chalcophilic properties in the meteorites. A cosmic atomic abundance for antimony of 0.40 ($Si = 10^6$) was obtained based on 2 Type I carbonaceous chondrites analyzed. This value is considerably higher than predicted by current theories of nucleosynthesis. Ordinary chondrites are relatively uniform with respect to their antimony abundances and average 0.11 ($Si = 10^6$). Using the available data a crustal antimony abundance of approximately 0.2 ppm is indicated.—*from* Authors' abstract

04992 **Tardif, Lauréan.** Les sols des îles de la Madeleine [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 15, 1967.

05263 **Taylor, Hugh P., Jr.** Stable isotopes, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 686–693, 1967.

This report covers research on stable isotope geochemistry published from 1963-66 by scientists in the United States. Most results were obtained on isotopes of the light elements, mainly H, C, O, and S. Work on geothermometry, meteorites and tektites, igneous and metamorphic rocks, sedimentary rocks, natural waters, ore deposits, and "miscellaneous" is reviewed. A bibliography of pertinent works is given.—DBV

05327 **Taylor, Hugh P., Jr.** The zoned ultramafic complexes of southeastern Alaska, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 97–121, illus., tables, 1967.

The belt is 35 miles wide, 350 miles long, and contains 35 ultramafic complexes, which are similar enough to have had a similar origin. The belt parallels the trends of Paleozoic and Mesozoic metamorphism and is cut by late Mesozoic intrusions. The general characteristics are described, and numerous chemical analyses are included. Eight of the major bodies are described in detail. The magmas are considered to have been ultramafic, as gravity fractionization will not explain certain features, and several kinds of magma are suggested. Numerous experimental phase diagrams are included to show petrogenesis. Seven points are made to support multiple intrusion.—HRC

05132 **Texas University Bur. Econ. Geology.** Geologic atlas of Texas, Sherman sheet (Walter Scott Adkins Memorial Edition): Austin, Tex., Texas Univ. Bur. Econ. Geology, scale 1:250,000, separate text, 1967.

05344 **Thomas, Chester E., Jr.; Bednar, Gene A.; Thomas, Mendall P.; Wilson, William E.** Hydrogeologic data for the Shetucket River basin, Connecticut: Connecticut Water Resources Bull. 12, 48 p., illus., tables, 1967.

The Shetucket River basin occupies about 508 sq mi in the eastern part of Connecticut. The water resources of the basin are evaluated in a companion report (ibid., Bull. 11, M. P. Thomas and others, 1967); data presented here document and supplement that information. Tables show records of wells, logs of wells and test holes, analyses of sediment samples, streamflow records, chemical analyses of precipitation and water samples, and fluoride analyses of ground water in the southwestern part of the basin.—MCM

Thomas, Chester E., Jr. *See* Thomas, Mendall P. 05345

Thomas, Mendall P. *See* Thomas, Chester E., Jr. 05344

05345 **Thomas, Mendall P.; Bednar, Gene A.; Thomas, Chester E., Jr.; Wilson, William E.** Water resources inventory of Connecticut—Pt. 2, Shetucket River basin: Connecticut Water Resources Bull. 11, 96 p., illus., tables, 1967.

The Shetucket River basin has three aquifers: (1) stratified drift—yield more than 100 gpm, permeability average about 1,900 gpd/sq ft; (2) till—tapped chiefly by dug wells with yields of more than 200 gpd, where not impermeable or too thin; and (3) bedrock—tapped chiefly by drilled wells, about 90 percent of which will supply at least 3 gpm. Long-term yields estimated for 15 areas favorable for development ranged from 1.3 to 61.8 mgd. Chemical quality of water is generally good to excellent. Basic data for the basin are presented in Bull. 12, 1967 (C. E. Thomas, Jr., and others).—MCM

05199 **Thomas, Paul D.** Geodesy and Earth studies: Internat. Jour. Oceanology and Limnology, v. 1, no. 4, p. 254–276, illus., 1967.

A short review is given of the hypothesized structure of the Earth, its figure (size and shape), the contribution of artificial satellites in geometric and dynamic modes with comparisons of the geoidal mappings as obtained. Finally the relation of geodesy to the other earth sciences is briefly discussed and the need for geodetic control in ocean areas, or marine geodesy.—Author's abstract

Thompson, J. B., Jr. *See* Trask, N. J., Jr. 04921

Thompson, R. M. *See* McTaggart, K. C. 05352

05061 **Thompson, R. N.; Mackenzie, W. S.** Feldspar–liquid equilibria in peralkaline acid liquids—An experimental study: Am. Jour. Sci., v. 265, no. 8, p. 714–734, illus., table, 1967.

Liquidus surfaces were determined at $P_{water} = 1{,}000$ bars in the $NaAlSi_3O_8$–$KAlSi_3O_8$–SiO_2 system plus 5 percent Na_2SiO_3 or $NaFeSi_2O_6$ or K_2SiO_3 or $NaKSiO_3$. General patterns of the liquidus surfaces and of distribution of feldspar–liquid tie lines are similar to those in the system $NaAlSi_3O_8$–$KAlSi_3O_8$–SiO_2, but general levels of liquidus temperatures are lower and residual liquids tend to have higher Na_2O/K_2O ratios. The "orthoclase effect" of Bailey and Schairer (1964) is amplified and clarified by new data.—HRC

00007 **Thurston, William.** International Union of Geological Sciences: Geotimes, v. 13, no. 1, p. 13–14, tables, 1968.

During 1967, the Union established two more commissions and a committee, accepted the transfer of the Committee on History of Geological Sciences from the International Geological Congress, and granted affiliation to three more international organizations. Membership was increased by addition of Uganda in 1966 and Botswana in 1967. The 48,000 dollar budget was used to support the work of commissions and committees, to help sponsor symposiums, to print and distribute the Geological Newsletter, and to meet nominal expenses of the central office. The countries belonging to IUGS, the organizations within it, and its affiliates are tabulated, and conferences and symposiums listed.—ESL

05200 **Tilton, J. G.** Channel sandstones of the Pittsburgh coal horizon: Soc. Mining Engineers Trans., v. 238, no. 4, p. 403–408, illus., 1967.

In the Pittsburgh coal horizon (West Virginia–Pennsylvania–Ohio) there are areas where it is disturbed by sandstone cutouts which can seriously hamper mining operations. Because these channels often cut out the coal abruptly, they are difficult to detect by core drilling, and mine operators trust largely to luck to avoid them. The following sources of information and guides are given to aid the operator before mining is started: Where the overlying strata are sandy shales and sandstones, the possibility of cutouts in the coal increases markedly, and cross sections of these strata can determine the sandstone trend; oil and gas well logs are a source of information; lithofacies maps of roof strata and isopach maps of sandstone and coal could be helpful as cutouts seem to occur in thicker parts of the sandstone and close to abnormal thicknesses of coal.—ESL

Tinch, D. H. *See* Schmidt, A. W. 04991

04990 **Tixier, M. P.; Alger, R. P.** Log evaluation of nonmetallic mineral deposits, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. R1–R22, illus., tables, 1967.

If the mineral represents a significant fraction of the formation volume and has characterizing properties, modern logging methods may be used for identification. For sulfur deposits, either density or sonic logs provide good resolution when compared with porosity computed from neutron or resistivity logs. Trona beds are identified by a sonic reading of approximately 65 microsec/ft, neutron porosity index of about 40 percent, low natural radioactivity, and pronounced hole enlargement. Gamma-ray logs are used to detect potash; neutron, sonic, and density logs, in various combinations, augment the gamma-ray data in such studies. Coal beds are characterized by high resistivities, and by high apparent porosities on sonic, neutron, and density logs. Density logs are particularly suited for evaluation of yield from oil shales.—*from* Authors' abstract

04906 **Toomey, Donald Francis.** Additional occurrences and extension of stratigraphic range of the problematical micro-organism *Nuia*: Jour. Paleontology, v. 41, no. 6, p. 1457–1460, illus., 1967.

Representatives of the problematical micro-organism *Nuia siberica* Maslov, 1954, have been found in three widely spaced areas of North America. These occurrences extend the stratigraphic range of *Nuia* from Late Cambrian? into Middle Ordovician (rocks of Porterfieldian age). *Nuia siberica* is found in the Day Point, Crown Point, and Valcour Limestones (Chazyan) of the Champlain Valley of northern New York and western Vermont, the Bromide Formation (Middle Ordovician) of southern Oklahoma, and the Black Rock Formation (Early Ordovician) of northeastern Arkansas. Significantly, *Nuia* is found in both biostromal layers and mound horizons and apparently is intimately associated with various algal forms, lithistid sponges, and spongelike organisms.—Author's abstract

04921 **Trask, N. J., Jr.; Thompson, J. B., Jr.** Stratigraphy and structure of the Skitchewaug nappe in the Bernardston area, Mass. and N. H. and Vt., Trip J *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercoll. Geol. Conf., 59th Ann. Mtg., Amherst, 1967: [New Haven, Conn., Yale Univ. Dept. Geology] p. 128–142, illus., table, 1967.

The area covered by this field trip lies on the west flank of the Bronson Hill anticlinorium, a series of complex gneiss domes that extends from northern New Hampshire to Long Island Sound. The Skitchewaug nappe, extending roughly 70 miles from Bernardston, Mass., north to Bellows Falls, Vt., is a major recumbent fold involving the Ordovician–Devonian "New Hampshire sequence" of metamorphic rocks, essentially the same formations as those draping the flanks of the domes; these have been downfolded into the synclinal areas between the Vernon, Keene, and Alstead domes. The Clough Quartzite, a persistent marker horizon containing Silurian fossils at Bernardston, Mass., and 65 miles to the north at Croydon Mountain, N. H., has aided in interpreting the stratigraphy and structure of the autochthonous and inverted sequence. Geologic sketch maps and structure sections are shown.—VMJ

04960 **Traverse, A.; Ames, H. T.; Kremp, G. O. W.** (compilers). Catalog of fossil spores and pollen—V. 27, Carboniferous megaspores and microspores: University Park, Pa., Pennsylvania State Univ. Palynol. Labs., 152 p., illus., 1967.

This volume contains protologs of new taxa in 13 papers published between 1929 and 1961 on Carboniferous spores from Brazil, Egypt, Great Britain, Poland, Spain, Turkey, U.S., and U.S.S.R. Eight new genera, 120 new species, and 34 new infraspecific taxa are treated. U.S. horizons and localities are: Lower Pennsylvanian coals of the Michigan basin (C. A. Arnold, 1950, 1961; H. H. Bartlett, 1929); Pottsville coals of Indiana (G. K. Guennell, 1958); Herrin (No. 6) coal of Illinois (J. M. Schopf, 1936, 1938). Two U.S. genera *Monoletes and Parasporites*, are described by Schopf, who also emends the description of *Sporites* H. Potonie 1893. Inclusion of a considerable number of megaspores in this volume is a new departure for the Catalog; many of the "pages" run to more than the customary 1 or 2 sheets because of long descriptions of megaspores.—VMJ

Trembath, L. T. *See* Pajari, G. E. 05105

05028 **Tremblay, Joseph.** Géochimie de l'eau souterraine de la région de Beloeil [abs.]: Assoc. Canadienne-Française Av. Sci. Annales 1965–66, v. 33, p. 91, 1967.

04931 **Trexler, David W.** Stratigraphic distribution of Upper Cretaceous nannoplankton (coccoliths) in central and northern Colorado and the Black Hills region: Jour. Paleontology, v. 41, no. 6, p. 1355–1364, illus., 1967.

Abundant and diversified coccolith assemblages are found in the lower part of the marine Cretaceous deposits of the Western Interior. Samples examined from 3 areas in central and northern Colorado and 2 areas in the Black Hills region of South Dakota and Wyoming yielded 46 different forms of coccoliths from the Benton–Niobrara interval. Of these, 8 are different from any previously described species. Five provisional biostratigraphic intervals, ranging from Cenomanian to Campanian in age, are delineated on the basis of coccoliths. The coccoliths are important rock formers in the Benton–Niobrara interval and are useful in interpreting paleoceanography.—*from* Author's abstract

Trunz, J. P., Jr. *See* Pirson, S. J. 04888

05380 **Tucker, L. R.** Geophysical activity in 1966: Geophysics, v. 32, no. 6, p. 1047–1072, illus., tables, 1967.

This report on 1966 geophysical activity in the free world includes petroleum and mining as usual (the latter given separately at the end; see Elliott and Kellogg in same issue); in addition, activities for engineering and ground-water purposes and some data on governmental and institutional oceanographic surveys are included for the first time. Following previous custom, activity is reported for the Western Hemisphere, including the United States, Canada, Mexico, and Central America + West Indies; and the Eastern Hemisphere, including Europe, Africa, Middle East, Far East, and Australia + New Zealand.—DBV

05325 **Tuke, M. F.; Baird, D. M.** Klippen in northern Newfoundland, *in* Appalachian tectonics: Royal Soc. Canada Spec. Pub. 10, p. 3–9, illus., 1967.

Two contemporary rock sequences outcrop in northern Newfoundland. An allochthonous sequence of slate, greywacke, and volcanic and ultrabasic rock occurs in three slices and lies on shales which rest conformably on a shelf sequence widespread to the west. The trends of slickensides and the dip of axial planes indicate movement toward the northwest. The allochthonous rocks are thought to have moved by gravity sliding from a source about 60 km to the southeast.—Authors' abstract

Tupper, W. M. *See* Gleeson, C. F. 05101

05162 **Uchupi, Elazar.** Slumping on the continental margin southeast of Long Island, New York: Deep-Sea Research, v. 14, no. 5, p. 635–639, illus., 1967.

Continuous seismic reflection profiling of the continental margin southeast of Long Island, New York, has revealed modification of sediments by slumping and gravitational sliding. The cause of slumping is not known but may have been due to rapid sedimentation which caused an increase in sediment pore-water pressure or to movement triggered by an earthquake. Fossil evidence and stratigraphic relations suggest that mass movement may have occurred as recently as late Tertiary or Pleistocene times.—VSN

05167 **Uchupi, Elazar.** The continental margin south of Cape Hatteras, North Carolina—Shallow structure: Southeastern Geology, v. 8, no. 4, p. 155–177, illus., 1967.

Seismic profiles, drill-hole data, and dredge hauls show that the geologic history of this part of the continental margin has been complex, marked by carbonate deposition, erosion by the Gulf Stream, and differential subsidence. The escarpment east of the Blake Plateau may represent a chain of Cretaceous algal banks; a thick sequence of shallow-water carbonate sediments collected on the plateau behind them. After the banks died during Late Cretaceous submergence, the Gulf Stream extended its course across the plateau, and during the Tertiary, deposition shifted westwards to the present shelf-break, where 600–1,000 m of sediments were deposited, prograding against the westward margin of the Gulf Stream in the south, and building out beyond the plateau to the north where the Gulf Stream was farther offshore. Vertical uplifts with erosion by the Gulf Stream during the Pleistocene modified this.—*from* Author's abstract

04997 **Urey, Harold C.** Parent bodies of the meteorites and the origin of chondrules: Icarus, v. 7, no. 3, p. 350–359, 1967.

Recent evidence indicates that some of the chondritic meteorites may come from the Moon or Mars. The arguments leading to such a conclusion are reviewed. Such places of origin require that the origin of the chondrules be reconsidered. It is concluded that a collisional process is the most reasonable one consistent with a lunar origin.—Author's abstract

05194 **Uyeno, T. T.** Conodont zonation, Waterways Formation (Upper Devonian), northeastern and central Alberta: Canada Geol. Survey Paper 67-30, 21 p., illus., tables, 1967.

Two conodont zones are recognized in the Waterways Formation of northeastern and central Alberta. Conodonts of the lower members, the Firebag and Calumet, may be assigned to the Lower *Polygnathus asymmetrica* Zone, and those of the upper members, the Christina, Moberly, and Mildred, to the Middle *Polygnathus asymmetrica* Zone. Both zones are defined in the Rhenish Schiefergebirge of Germany, and are the lowermost Upper Devonian conodont zones of the *Manticoceras*-Stufe. Only platform and blade-like conodonts are considered; they consist of 28 species and 5 subspecies, referable to 10 genera. Six new taxa are described and illustrated; the following are formally named: *Ancyrodella rotundiloba binodosa, Nothognathella klapperi, Polygnathus incompleta, and Polygnathus norrisi.*—*from* Author's abstract

05185 **Vaisnys, J. Rimas.** Dislocation velocities and deformation in the mantle, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1-4, p. 67-72, 1967.

It is assumed that the mechanical properties of the mantle may be described in terms of dislocation behaviour and some of the consequences are examined. Geologically acceptable strain rates and a mantle attenuation characterized by a frequency dependent Q are found in this approach. Maxima are expected in the strain rate and attenuation with depth.—Author's summary

Vallée, M. *See* Gold, D. P. 05116

05244 **Vallier, Tracy Lowell.** The geology of part of the Snake River Canyon and adjacent areas in northeastern Oregon and western Idaho [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1585B, 1967.

05053 **VanDiver, Bradford B.** Contemporaneous faulting-metamorphism in Wenatchee Ridge area, Northern Cascades, Washington: Am. Jour. Sci., v. 265, no. 2, p. 132-150, illus., table, 1967.

The distinctive main phase of the White River Orthogneiss in the Wenatchee Ridge area of Washington consists of directionless and gneissose meta-quartz diorites that locally grade into dioritic rocks. These are separated from the Chiwaukum Schist-Wenatchee Ridge Gneiss complex by a zone of amphibolitic blastomylonite schists, remnant layers and lenses of the main orthogneiss, and a few ultramafic tectonic slices. This zone is interpreted as derived from the White River unit by high-angle reverse faulting. The White River mass is partly, and perhaps completely, divided into three segments by two septa which trend nearly parallel to the boundary zone. Mineralogically, the rocks are largely adjusted to medium-grade metamorphic conditions. The main White River mass and the metamorphic fault zones differ principally in their degree of deformation and relative abundance of more salic and mafic rock types.—*from* Author's abstract

05109 **VanIngen, R.** Granite studies related to ore formation in the eastern townships, Quebec [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66-54, p. 277-278, 1967.

05409 **VanSchmus, W. R.** Polymict structure of the Mezö-Madaras chondrite, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 2027-2042, illus., tables, 1967.

Most of the Mezö-Madaras chondrite is similar to other "unequilibrated ordinary chondrites" in that the chondritic texture is excellently preserved; the olivine and pyroxene are of very heterogeneous compositions and several of the chondrules contain primary Na-Al-Si glasses. In addition to normal chondritic material, fragmental inclusions of other types of chondritic material are present. One type consists of very small chondrules and silicates, sulfide, and metal in a black, opaque, carbonaceous matrix. In other inclusions, silicates show a range of equilibration

and are more homogeneous than in most of the Mezö-Madaras. The polymict structure in Mezö-Madaras is interpreted as the result of catastrophic mixing of surface and near-surface material on the chondritic parent body during or after formation.—*from* Author's abstract

04950 **vanWijk, M. G.** Photogrammetry applied to avalanche studies [with French and German abs.]: Jour. Glaciology, v. 6, no. 48, p. 917–933, illus., tables, 1967.

Artificially induced snow avalanches were studied by stereophotogrammetric techniques. Avalanche slopes were contoured from stereophotographs taken before and after avalanching; the outline of the front at certain time intervals and the contours of the snow cloud were plotted. Volume of the snow cloud at four different stages of the avalanche was determined from the maps and computed independently from coordinate readings made in the stereo models. Standard errors of both methods were estimated to be 450 m^3 and 290 m^3, respectively, representing errors of 5 and 3 percent of the average cloud volume. All photographs (oblique-ground) were taken at determined time intervals so that velocity of the avalanche front could be determined.—LLR

05328 **Vokes, Emily H.** Cenozoic Muricidae of the western Atlantic region—Pt. 3, *Chicoreus (Phyllonotus)*: Tulane Studies Geology, v. 5, no. 3, p. 133–166, illus., table, 1967.

There are 18 species of the muricine subgenus *Phyllonotus*, three extant. The earliest known species here referred to *Phyllonotus* is from the lower Oligocene Red Bluff Clay of Mississippi. The group is derived from a *Hexaplex* ancestor. *Phyllonotus* gave rise to the subgenera *Chicoreus* s.s. and *Siratus*. An endemic western Atlantic form, *Phyllonotus* migrated through the Isthmian passage, probably in late Miocene, and evolved into the four species presently known from the eastern Pacific. The subgenus is and has always been confined to the New World. All 18 western Atlantic Cenozoic species are treated systematically, including one new *Chicoreus (Phyllonotus) leonensis* E. H. Vokes, from the Choctawhatchee Formation, northern Florida.—*from* Author's abstract

00025 **Walker, George W.; Swanson, Donald A.** Summary report on the geology and mineral resources of the Harney Lake and Malheur Lake areas of the Malheur National Wildlife Refuge, north-central Harney County, Oregon: U.S. Geol. Survey Bull. 1260-L, p. L1–L17, illus., 1968.

The two lake areas occupy the shallow center of Harney Basin, a broad structural and physiographic depression filled by varieties of silicic to mafic volcanic and sedimentary rocks, and unconsolidated surficial deposits. All rocks in the candidate areas are Pliocene or younger. Northwest-trending normal faults form prominent scarps. No minerals have been produced and no mineral commodities exposed can be mined economically at present. Altered beds of clinoptilolite and potassium feldspar dip into the areas; determination of their subsurface distribution and volume would require drilling or other underground exploration. Zeolites and bedded potassium feldspar are now entering the industrial mineral market and their future value is uncertain. The complexly faulted volcanic region is unfavorable for accumulation of petroleum, there is no evidence of minerals in economic quantities, and the geothermal power potential is small.—*from* Authors' abstract

00026 **Walker, George W.; Swanson, Donald A.** Summary report on the geology and mineral resources of the Poker Jim Ridge and Fort Warner areas of the Hart Mountain National Antelope Refuge, Lake County, Oregon: U.S. Geol. Survey Bull. 1260-M, p. M1–M16, illus., 1968.

The two candidate areas for the National Wilderness Preservation System are part of an upraised and titled fault block—rocks principally volcanic in origin, have been faulted, uplifted, and tilted eastward, the older rocks having been more strongly deformed than the younger. No mineral raw materials in the category of leasable minerals have been produced and no mineral commodities can be mined economically at present. Future value of altered beds of zeolites (principally clinoptilolite) of the Fort Warner area cannot be determined now. Small deposits of precious opal and low-grade bentonite occur locally, but are not of

commercial importance. The complexly faulted volcanic area is not favorable for accumulation of petroleum or for commercial mineral deposits.—*from* Authors' abstract

Walker, H. J. *See* Arnborg, Lennart. 05337

05110 **Walker, J. L.** Primary geochemical dispersion and its application to exploration and mining programs [abs.], *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 279–280, 1967.

05419 **Walter, Louis S.** Tektite compositional trends and experimental vapor fractionation of silicates, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 2043–2063, illus., tables, 1967.

Recent observations indicate that Muong Nong type tektites, which are highly structured, contain coesite, and have a high silica content, may be primary tektite material. High-temperature experiments at atmospheric pressure show that, starting with material of this composition, vapor fractionation results in a residuum which follows the compositional trends of tektites in general. There is a significant difference between the tektite trends and those produced in experiments under reducing conditions.—Author's abstract

Walter, Louis S. *See* Dundon, Robert W. 05427

Walther, H. C. *See* Meese, A. D. 04988

05384 **Walton, William C.; Hills, David L.; Grundeen, Gordon M.** Recharge from induced streambed infiltration under varying groundwater-level and stream-stage conditions: Minnesota Univ. Water Resources Research Center Bull. 6, 42 p., illus., tables, 1967.

In evaluating groundwater resources, streambeds must be simulated in mathematical and analog models in such a way that the following conditions are taken into consideration: (1) leakage of water through a streambed is directly proportional to drawdown beneath the streambed until the water table declines below the streambed; thereafter, induced infiltration remains constant; (2) if the water table remains below the streambed, leakage of water through the bed is directly proportional to the average depth of water. The application of semi-conductors to hydrogeologic systems analysis using electric analog computers has unlimited research possibilities. [An aquifer-stream system in the Venice area, Ohio, is cited as an example.]—*from* Authors' conclusions

Wanek, Alexander A. *See* Cobb, Edward H. 00024

05245 **Ward, Albert Noll, Jr.** Pre-Pennsylvanian stratigraphy of the southern San Juan Mountain area in southwestern Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 4, p. 1585B–1586B, 1967.

Ward, John R. *See* Bayne, Charles K. 05174

05288 **Ware, T. Preston, Jr.** Memorial to Paul J. Fly (1907–1967): Am. Assoc. Petroleum Geologists Bull., v. 51, no. 12, p. 2477, portrait, 1967.

Warner, Albert J. *See* Johnson, Gary D. 05081

05094 **Warren, Harry V.; Delavault, Robert E.; Cross, Christine H.** Some problems in applied geochemistry, *in* Symposium on geochemical prospecting, Ottawa, 1966, Proc.: Canada Geol. Survey Paper 66–54, p. 253–264, tables, 1967.

The authors discuss some of the practical problems associated with soil, water, and vegetation sampling, particularly in Canada, where many soils are transported, and geologically speaking, young, without a well-developed distinctive plant ecology.—MST

05361 **Warren, Harry V.; Delavault, Robert E.; Cross, Christine H.** Possible correlations between geology and some disease patterns: New York Acad. Sci. Annals, v. 136, art. 22, p. 657–710, illus., tables, 1967.

In appraising the relation of animal fats to multiple sclerosis, study of disease patterns in Canada and Europe disclosed some geological data. High prevalence of multiple sclerosis appears in districts where soils have abnormal amounts of copper, zinc and lead; in at least two such localities the mortality rate is high, and specifically above normal for cancer of the stomach. A significant bearing of inhaled or ingested polonium–210 on disease is supported. Organic matter in soils seems to be a complicating factor rather than cause in itself of stomach ulcer. In epidemiological studies, geographical plotting of environmental factors should follow geochemically significant areas.—GDC

05320 **Washburn, A. L.** Instrumental observations of mass-wasting in the Mesters Vig District, northeast Greenland: Medd. om Grønland, v. 166, no. 4, 296 p., illus., tables, 1967.

Quantitative observations of mass wasting were accumulated for five years and many are tabulated here. The experiment sites ranged in mean gradient from 2.5° to 25° and had a spectrum of grain-size, moisture, and vegetational characteristics which permitted comparisons. A theodolite was used. Frost creep and gelifluction can be distinguished quantitatively from each other. Moisture influence in gelifluction is more important than gradient or vegetation. Significant gelifluction probably occurs only at moisture values approximating or exceeding the Atterberg liquid limit. Frost creep and creep due to wetting and drying tend to be associated with a retrograde movement that reduces the amount of creep that would otherwise be present. Numerous other conclusions are discussed, all of which apply to the Mesters Vig area only.—*from* Author's abstract

Wasserburg, G. J. *See* Burnett, D. S. 05319

05408 **Wasson, John T.; Kimberlin, Jerome.** The chemical classification of iron meteorites—[Pt.] 2, Irons and pallasites with germanium concentrations between 8 and 100 ppm, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 2065–2093, illus., tables, 1967.

Concentrations of Ni5Ga, Ge and Ir are given for 61 iron meteorites and 6 pallasites having 8–100 ppm Ge, and 8 irons having <8 ppm Ge. A new resolved chemical group, composed of irons which appear to be genetically related, is described as having two distinct branches (IIIA–24 irons, IIIB–14 irons). A strong positive correlation between concentrations of Ge or Ga and Ni is found for IIIA, whereas IIIB shows a negative correlation. Arguments given indicate that pallasites form an additional resolved group. Three new members of group IVA and one of IVB are reported. Compositional differences within resolved groups are discussed in terms of possible fractionation processes. Variations in composition within each group are associated with the original radial distribution within the parent body.—*from* Authors' abstract

04984 **Watt, Harold B.; Akin, T. B.** Tricore—A continuous sidewall core cutter, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. U1–U9, illus., tables, 1967.

A new wireline coring device saws a 60 inch long triangular sample of the formation with a pair of cutters which move along the borehole wall parallel to the axis of the tool. The formation sample retrieved is undisturbed by the cutting operation and retains the mud cake in place on the surface adjacent the borehole. Cores may be taken in boreholes of 7 7/8 inch diameter or larger. This device makes it possible to retrieve continuous cores in selected zones for quantitative determination of rock properties and for qualitative examination of strata characteristics such as dip and fracturing. Correlation and comparison of these triangular cores with logging measurements provides a new means for studying the effects of mud cake and invasion. Results of field tests are discussed and the characteristics of retrieved rock samples and mud cakes are described.—*from* Authors' abstract

Webb, J. S. *See* Nichol, Ian. 05089

05032 **Weber, Jon N.** Factors affecting the carbon and oxygen isotopic composition of marine carbonate sediments—Pt. 1, Bermuda: Am. Jour. Sci., v. 265, no. 7, p. 586–608, illus., tables, 1967.

Investigation of carbon and oxygen isotopic composition of Recent carbonate sediments collected from open and enclosed lagoon, reef, and beach environments in Bermuda suggests that the carbon isotopic composition, together with other data, may be a valuable geochemical indicator of environment of marine carbonate rocks.—DLD

05071 **Webster, Ruth M.; Dodd, John D.** Recent pollen deposition in Miller's Bay, Lake Okoboji, Iowa: Iowa Acad. Sci. Proc. 1965, v. 72, p. 73–83, illus., tables, 1967.

Proportional counts (200/sample) of pollen present in nine samples of surface sediments from a settling basin in Miller's Bay, Lake Okoboji, Iowa, are summarized. In order of decreasing abundance the types of pollen listed are Compositae, *Quercus*, Gramineae, *Pinus*, *Ulmus*, *Picea*, *Carya*, *Tilia*, *Juglans*, *Ostrya*, *Fraxinus*, *Betula*, *Salix*, *Acer negundo*, fern (spores), *Celtis*, *Myriophyllum*, *Sparganium*, *Typha*, *Alnus*, *and Potamogeton*. The period of "pollen rain" for *Tilia americana* was determined to be from June 27 to July 14 (in 1964). Pollen found in algal mats collected during this period contained 15 types of pollen, of which *Tilia* pollen was the most abundant.—Authors' abstract

05180 **Weertman, J.** The effect of a low viscosity layer on convection in the mantle, *in* Non-elastic processes in the mantle—Internat. Upper Mantle Comm. Symposium, Newcastle-upon-Tyne, 1966, Proc.: Royal Astron. Soc. Geophys. Jour., v. 14, nos. 1–4, p. 353–370, illus., 1967.

If thermal convection occurs in the Earth's mantle, it also may occur in the Moon and Mars; however, surface morphology of the Earth, believed by many to arise ultimately from mantle convection, is markedly different from that of the Moon and Mars, possibly due to the presence of a low velocity or low creep layer in the mantle, which changes the amount of coupling between outer crust and mantle convection. Calculations show that the deeper in the mantle the low viscosity layer, the greater the coupling of the outer crust to mantle convection currents and vice versa. Because of interdependence between temperature, pressure, and depth of the low viscosity layer, such layers would lie much closer to the surface in Mars and the Moon than in the Earth, hence outer crusts of Mars and the Moon are more nearly decoupled from the interior than is the Earth.—DBV

Weidie, A. D., Jr. *See* Murray, Grover E. 05114

Weisinger, R. C. *See* Northwood, E. J. 05382

00011 **Weissenborn, A. E.; Snavely, Parke D., Jr.** Summary report on the geology and mineral resources of Flattery Rocks, Quillayute Needles, and Copalis National Wildlife Refuges, Washington: U.S. Geol. Survey Bull. 1260-F, p. F1–F16, illus., geol. map, 1968.

Flattery Rocks, Quillayute Needles, and Copalis National Wildlife Refuges, off the coast of the Olympic Peninsula, have a land area of 247 acres and consist of numerous small islands, sea stacks, and rocks that rise above a wave-cut platform. They are in a belt of folded and faulted marine Eocene to Pliocene sedimentary and volcanic rocks; the belt borders the eastern margin of a depositional basin on the continental shelf that probably contains a thick sequence of upper Tertiary rocks. Pleistocene glaciofluvial deposits blanket Tertiary strata along the belt. Although there has been no commercial production of oil and gas in this coastal area, small production was obtained from a well a few miles south; the area may include structural or stratigraphic traps. The small amounts of gold, magnetite, ilmenite, or lignite are not significant.—*from* Authors' abstract

00020 **Weissenborn, A. E.; Snavely, Parke D., Jr.** Summary report on the geology and mineral resources of the Oregon Islands National Wildlife Refuge, Oregon: U.S. Geol. Survey Bull. 1260–G, p. G1–G4, illus., 1968.

The Oregon Islands National Wildlife Refuge consists principally of Goat Island, a small island off the coast of Oregon south of Cape Ferrelo and northwest of Brookings. Sandstone beds of the Dothan Formation, which crop out on the adjacent mainland, probably make up most of the island and nearby islets. Except for possible use of the sandstone as a source of crushed stone or other types of construction stone, the island has no known mineral resources of economic value.—Authors' abstract

00021 **Weissenborn, A. E.; Snavely, Parke D., Jr.** Summary report on the geology and mineral resources of the Three Arch Rocks National Wildlife Refuge, Oregon: U.S. Geol. Survey Bull. 1260–H, p. H1–H6, illus., 1968.

Three Arch Rocks National Wildlife Refuge (three volcanic-rock islands offshore from Oceanside, Oreg., total land area 17 acres) is composed of basalt, part of an extensive body that forms cliffs on the nearby mainland shore. The basalt rests on a thick sequence of Tertiary marine sedimentary rocks which have a theoretical potential for oil or gas, but no surface structures favorable for accumulation are known in the immediate vicinity. Basalt of the islands has only nominal value as a source of crushed stone for construction purposes, because equally suitable and more conveniently located sources are widely distributed along the Oregon coast. Aside from the basalt flows of which the islands are formed, the refuge contains no known mineral resources.—*from* Authors' abstract

Weller, W. W. *See* Pankratz, L. B. 05305

04923 **Wessel, James M.; Hand, Bryce M.; Hayes, Miles O.** Sedimentary features of the Triassic rocks in northern Massachusetts, Trip L *in* Guidebook for field trips in the Connecticut Valley of Massachusetts—New England Intercollegiate Geol. Conf., 59th Ann. Mtg., Amherst, Mass., 1967: [New Haven, Conn., Yale Univ., Dept. Geology] p. 154–165, illus., 1967.

Triassic sedimentary rocks and sedimentary structures are observed in a linear trough 16 miles long north of Amherst to Turner Falls, Mass. Fanglomerates, fluvial sandstones, and mudrocks were deposited in the Connecticut Valley Lowland on the downfaulted block west of the Triassic border fault. Late Triassic sedimentation in the area was dominated by large alluvial fan complexes (Mt. Toby Conglomerate and Turner Falls Sandstone). Preserved anatomy of two of these fans is observed, and hydraulic conditions during sedimentation are interpreted. The interpretation is illustrated by a sediment dispersal diagram for the area, and diagrams of succession of bedforms that develop in alluvial channels with increasing current velocity.—VMJ

05341 **Westgate, J. A.; Dreimanis, A.** The Pleistocene sequence at Zorra, southwestern Ontario: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1127–1143, illus., tables, 1967.

The Pleistocene sequence at the Canada Cement Plant quarry is remarkable; nine distinct tills, intercalated with stratified drift, are from the Erie, Huron, and Georgian Bay lobes. Lithologic and till fabric analyses, plus surface orientations, are used to determine the parent ice lobe of each till. The lower units are from the Erie; the next are from the Huron and Georgian Bay; the next above from the Erie; and the upper tills were deposited by the Huron lobe. The Zorra tills are correlated with those of the Nith River between the Thames River and Lake Ontario. The lower ones are Early Wisconsin, the middle Mid-Wisconsin, and the uppermost Late Wisconsin.—HRC

05371 **Whitaker, S. H.** Geology and groundwater resources of the Wood Mountain area (72–G), Saskatchewan: Saskatchewan Research Council Geology Div. Map 5, scale 1:250,000, section, text, 1967.

Principal aquifers of the Wood Mountain area are: Cretaceous Belly River, Bearpaw, Eastend, Whitemud, and Frenchman Formations; Paleocene Ravenscrag

Formation, Tertiary gravel, and drift. Southwest of the Frenchman River, the Belly River occurs at shallower depths than in most of the area, and contains potable water at Monchy Custom Post. The Bearpaw could yield suitable water for small supplies in the northwestern area. About 80,000 gpd is obtained from a well at Bexhill in the Eastend, Whitemud, and Frenchman Formations, but probable yield from these formations is substantially less. Yields from the Ravenscrag will vary greatly, but it has potential for small supplies. Sustained yield of Tertiary gravel aquifers depends on amount of annual recharge. Drift aquifers in preglacial valleys yield up to 100,000 gpd. Analyses of ground water chemistry should be evaluated before exploration.—MCM

05058 **White, Donald E.** Some principles of geyser activity, mainly from Steamboat Springs, Nevada: Am. Jour. Sci., v. 265, no. 8, p. 641–684, illus., tables, 1967.

Natural geysers are near-surface expressions of large convection systems in which water of surface origin circulates to great depths (5,000 to 10,000 feet minimum). The circulating water must be heated mainly by thermal conduction through solid rocks from underlying molten or near-molten volcanic bodies at depths of 2 to 4 miles. Oxygen and hydrogen isotopes indicate that 95 percent of the water must be of surface origin. Geyser activity requires a restricted circulation system and minimal subsurface temperature of 150°C.—HRC

04892 **White, J. E.** The Hula Log—A proposed acoustic tool, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. I1–I5, illus., 1967.

Transient wave forms are presented for a proposed logging tool which is capable of exploiting flexural and torsional waves, as well as more familiar axisymmetric wave types. Torsional waves appear especially promising for investigating invaded zones and other inhomogeneities. The design of a transducer capable of generating and detecting the various waves is described briefly.—Author's abstract

05143 **Whitten, C. A.** Crustal movement, *in* IUGG quadrennial report (U.S.A.): Am. Geophys. Union Trans., v. 48, no. 2, p. 363–366, 1967.

As a result of the Alaska earthquake of March 1964, a ten-year research program has been proposed which includes a specific directive to intensify the study of crustal movement, particularly in seismic regions. Basic research and investigations relating to crustal movement that are of geodetic nature include (1) improved mathematical techniques for analysis of geodetic measurements, (2) modification of existing and development of new instrumentation and measuring techniques, and (3) more intensive search for zones of continuing creep or slippage along major faults. Progress in each of these areas since 1963 is outlined. A bibliography of pertinent works is given.—DBV

04974 **Wichmann, P. A.; Hopkinson, E. C.; Youmans, A. H.** Advances in nuclear production logging, *in* SPWLA Logging Symposium, 8th Ann., Denver, 1967, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. T1–T10, illus., 1967.

So-called "production logging" instruments are mainly used to make measurements within the borehole. Nuclear logs, especially the Neutron Lifetime Log, can detect fluid levels and sense the direction of fluid flow outside of the casing. The vertical movement of water outside casing can be observed by activation of oxygen as the fluids move past the 14 mev neutron source in the direction of a gamma ray dectector, and so locate the actual origin of produced water when channeling occurs. A new NLL instrument has been developed for logging through 2 1/2 inch tubing. Production logging techniques using this instrument to supplement other production logs are discussed.—*from* Authors' abstract

Wilcoxon, J. A. *See* Bramlette, M. N. 05135

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05030 **Wolff, R. G.** Weathering of Woodstock Granite, near Baltimore, Maryland: Am. Jour. Sci., v. 265, no. 2, p. 106–117, illus., tables, 1967.

The weathering of a conical mound of quartz monzonite, commonly known as the Woodstock Granite, near Baltimore, Md., results in the breakdown of the feldspars, primarily plagioclase, to form halloysite. The ratio of $4H_2O$-halloysite/$2H_2O$-halloysite increases with depth in the mound. Analyses of water samples obtained from two sampling points at different elevations within the mound show a higher concentration of dissolved solids at 2.5 feet below the surface than at 5.5 feet below the surface. These differences are attributed to the increasing cation exchange capacity of the halloysite with depth.—Author's abstract

05433 **Wolman, M. Gordon.** A cycle of sedimentation and erosion in urban river channels: Geog. Annaler, v. 49A, nos. 2–4, p. 385–395, illus., table, 1967.

Historical evidence and contemporary measurements in the Piedmont of Maryland indicate that successive changes in land use have been accompanied by changes in sediment yield and in the behavior of river channels. Sediment yields from forested areas in the prefarming era appear to have been less than 100 t/sq mi/yr. Yields from later agricultural lands in the same region range from 300 to 800 t/sq mi on large drainage areas. Lands marginal to expanding urban centers show a decline in sediment yield, except those exposed during construction, which can produce loads in excess of 100,000 t/sq mi/yr. Small channels become clogged during this period, and sediment removal by subsequent clearer flows is slow. Increased runoff from urban areas, with a decline in sediment yield, promotes bank erosion and channel widening.—*from* Author's abstract

00001 **Wood, John A.** Cosmochemistry: Geotimes, v. 13, no. 1, p. 10, table, 1968.

Unmanned spacecraft made the most significant advances last year in this field. Surveyors 5 and 6 sent back data showing that igneous products and processes are similar on Earth and Moon. Studies on meteorites and tektites in 1967 are reviewed also.—ESL

05418 **Wood, John A.** Olivine and pyroxene compositions in Type II carbonaceous chondrites, *in* Meteorites and tektites: Geochim. et Cosmochim. Acta, v. 31, no. 10, p. 2095–2108, illus., tables, 1967.

Random surveys were made of olivine and pyroxene compositions in 10 C2 chondrites. Olivine distributions were found to peak sharply at 0.6–2 mole percent fayalite, but grains containing up to 69 percent fayalite are also present, as noted by Fredriksson and Keil (1964). Among the C2 chondrites studied, five parameters were noted to vary: content of chondrules, content of Fe–Ni metal, pyroxene:olivine ratio, percentage of olivine with high fayalite contents, and modal fayalite content of the low-Fe^{2+} olivine peaks. These variations correlate with one another, although imperfectly, and it is suggested that they reflect stages through which primordial planetary or preplanetary material passed as it was more and more completely melted and reduced by early high-energy events.—*from* Author's abstract

Woollard, George P. *See* Coons, Richard L. 05281

Wyler, Rose. *See* Ames, Gerald. 05000

05324 **Wyllie, P. J.** Review, *in* Ultramafic and related rocks (P. J. Wyllie, editor): New York and London, John Wiley and Sons, p. 403–416, table, 1967.

A review of the highlights of 34 papers in a symposium on ultramafic rocks includes summaries of the petrogenesis of ultramafic rocks, stratiform intrusions, alkalic ultrabasics, and ultramafic rocks in orogenic belts. Results of geochemical analyses and evaluations on ultramafics lead to discussions regarding the nature of the rocks in the upper mantle.—HRC

05434 **Yatsu, Eiju.** Some problems on mass movements: Geog. Annaler, v. 49A, nos. 2–4, p. 396–401, illus., tables, 1967.

A hard and fast classification of mass movements can neither be given nor make sense, because its practical application to the actual or natural phenomena encounters great difficulties. For the time being a simplification is preferable to pinning for a too detailed classification of mass movements. This paper is chiefly concerned with clay minerals in areas of mass movements of flow— and slip—type in Canada [Quebec and British Columbia], compared with those in Scandinavia and in Japan, and it stresses the important role of swelling clay minerals.—Author's abstract

05317 **York, Derek.** The best isochron: Earth and Planetary Sci. Letters, v. 2, no. 5, p. 479–482, illus., 1967.

A pictorial presentation is made of the least squares cubic method of constructing straight lines such as Rb–Sr isochrons. It is shown that the somewhat complicated analytical expressions have simple pictorial representations.—Author's abstract

Youmans, A. H. *See* Wichmann, P. A. 04974

05040 **Young, Grant M.** Passive continents, spreading sea floors, and continental rises [discussion of paper by R. S. Dietz, 1966]: Am. Jour. Sci., v. 265, no. 3, p. 225–230, illus., 1967.

Young cites geologic evidence that is not in agreement with the hypothesis of Dietz (ibid., v. 264, no. 3, p. 177–193, 1966). Widespread distribution of Precambrian rocks near continental margins in North America indicates that little accretion can have taken place since the Precambrian, and widespread occurrence of Archean rocks in areas of younger orogenies contradicts Dietz's statement that orogens are tectonized only once. Dietz cites lack of deformation in Precambrian supracontinental strata as evidence of crustal stability; yet Proterozoic rocks of the Grenville province and other areas are highly deformed. The roughly concentric distribution of orogens in North America does not necessarily support a theory of continental accretion; paleomagnetic and structural evidence indicates that the Appalachian–Caledonian geosyncline is intracratonic.—VMJ

05323 **Yuan, T. L.; Gammon, Nathan, Jr.; Leighty, R. G.** Relative contribution of organic and clay fractions to cation-exchange capacity of sandy soils from several soil groups: Soil Sci., v. 104, no. 2, p. 123–128, tables, 1967.

Data from 83 Florida soils show that the clay content, organic-matter content, and CEC correlated with one another. The relationship between organic matter and CEC provided the best correlation. The CEC, for each gram of organic matter, varied from 1.38 to 1.97 me and for each gram of clay varied from 0.21 to 1.28 me.—JWH

Zahn, J. C. *See* Bull, C. 04970

Zardini, R. *See* Fyfe, W. S. 05042

Zlatkis, A. *See* Olson, R. J. 05402

00018 **Zuidema, Henry P.** Iron kettles from Canadian shale: Earth Sci., v. 21, no. 1, p. 17–18, illus., 1968.

Iron carbonate concretions weather out of the Devonian black shale at Ipperwash Beach, Lake Huron, near Ravenswood, Ontario; they are spherical, weight up to several hundred pounds, and are oil impregnated. Growth was probably by deposition from ground water after the land rose.—ESL

05395 **Zurflueh, Ernst G.** Applications of two-dimensional linear wavelength filtering: Geophysics, v. 32, no. 6, p. 1015–1035, illus., tables, 1967.

Wavelength filters permit separation of anomalies of different horizontal extents on magnetic and gravity maps. They can be used equally well for structural and topographic maps or for any other type of data amenable to gridding. Practical filters were developed following two series of cutoff wavelengths. Of special interest is the small size of filters as compared to steepness and smoothness of their wavenumber characteristics. Filters for any desired wavelengths can easily be derived from the described coefficient sets. Examples are given for the application of filters which can be used as regional, residual, and band-pass filters. The resultant maps are in the same units as the original maps. A given map can be divided into several wavelength components, and the sum of the components is equal to the original data.—*from* Author's abstract

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